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Vol. XIV., No. 3. 1888. Whole No. 46.

PROCEEDINGS

OF THE

UNITED STATES

NAVAL INSTITUTE.

VOLUME XIV.

EDITED BY
GEO. W. TYLER, CHAS. R. MILES,
W. F. WORTHINGTON.

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U. S. NAVAL WAR COLLEGE,
NEWPORT, R. I., *April* 20, 1888.

Sir:—The judges appointed to decide upon the merits of the five essays submitted in competition for the prize offered by the Institute for the year 1888, having carefully read them, and compared their individual opinions, report that the essay bearing the motto "Aunque me costó algun trabajo componerla" is deserving of the prize.

Although there is considerable merit in some of the other essays, the judges have not thought best to distinguish any one of them by a special "honorable mention."

Very respectfully.

A. T. MAHAN,
Captain, U. S. N.
W. T. SAMPSON,
Commander, U. S. N.
R. B. BRADFORD,
Lieut.-Commander, U. S. N.

LIEUT. CHARLES R. MILES, U. S. N.,
Secretary of the Naval Institute,
Annapolis, Md.

THE PROCEEDINGS

OF THE

UNITED STATES NAVAL INSTITUTE.

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PRIZE ESSAY FOR 1888.

"*Aunque me costó algun trabajo componerla.*"

TORPEDOES.

BY LIEUTENANT-COMMANDER W. W. REISINGER, U. S. N.

I.

THEIR PLACE IN NAVAL WARFARE.

In undertaking the subject of torpedoes, it will doubtless be as well to settle a few points at the outset as to the nomenclature and detail. For many years the word "torpedo" has been used to cover all classes of explosive cases used either upon the surface of the water or concealed under it. The great variety of forms for containing the explosives, the marked characteristics of some of these, and the varying conditions incidental to their use, have rendered it advisable to classify these weapons, and to-day we have two large groups of quite distinct features, known as *Torpedoes* and *Submarine Mines*. As now generally understood, the word *torpedo* applies to those boats or cases constructed to carry an explosive agent to a distance, that have within themselves their motive and directing powers, and are capable of firing their charges on contact. It

is to this torpedo that attention will be called in the subsequent pages. The term is qualified for descriptive purposes, and so we have controlled torpedoes, which, like *the* torpedo, carry their motive power with them, but are designed to be under the control of an operator who at a fixed station directs its flight and may fire its charge, using the electric current to work his will. Besides these, the other qualified torpedoes are towing torpedoes, drifting torpedoes, and the spar torpedo.

In the group of submarine mines are all cases or vessels constructed to contain explosive agents which are fixed in a certain position, being retained there either by dint of their own weight or by being moored securely to the bottom. This group may be subdivided into ground mines and constant depth mines, and are known by various names, as electric, electro-contact, electro-mechanical, and simple contact mines. These magazines of powder, gun-cotton, or dynamite are generally fired by the electric current.

In the discussion of the place of the torpedo in warfare in its fullest sense, it will be assumed that in the present awakening to the need of a naval power, now manifesting itself, we shall have swift cruisers and powerful ships for war purposes. The results of this rehabilitation of the Navy are being felt, and now that we have seen that the workshops and navy yards of the country can produce a modern ship of the more modest type, it is to be hoped that their energies and resources will be called upon to produce something of still higher type, until we shall have taken our former place amongst the naval powers of the world. We have the benefit of the experiments of years, made by our neighbors across the sea, and we are therefore in a position to avoid their errors and to reproduce and perhaps improve upon their successes.

No discussion of the torpedo can be comprehensive unless we may assume that we shall have both the weapon and its carriage in their most perfect forms. As I understand the subject under consideration, we are not limited to a spar torpedo carried by a slow moving wooden steam launch. With the new ships will come new steam launches of high speed and noiseless engines, to carry our old friend the spar, and a class of specially designed torpedo boats to carry our ideal torpedo. This assumption being allowed, we shall have our torpedo stepping into the arena coincidently with those other great actors in modern naval warfare—the ram and the high-powered gun.

These are all new factors in the problem of war, so far as our Navy is concerned, and in dealing with them we must depend to a great extent upon the experiences of others. This is on some accounts unfortunate, and if in the discussion some bias be observed, it may be due to this fact; for our opinions are likely to partake somewhat of the color of those who have had experience. However, having the opinions of the best known writers on these subjects before us, as well as many official reports now familiar to all the naval world, we shall find that one of the first steps necessary in considering all this data will be to sift it carefully.

Exaggerated notions as to the performances of some of the modern inventions are prevalent. Every one is expecting some new discovery which will revolutionize all accepted tactics and render war easy. Nor is this unnatural in the face of the startling changes which have taken place since 1860. Much is urged in behalf of the torpedo boat on the one hand, and these arguments are met on the other hand by confident assertions as to the infallibility of the rapid fire and machine guns. It is the privilege of our officers to weigh all the facts thus presented, and clearing them from all exaggerations, to endeavor to assign to each weapon its fair and reasonable share of power. Fish torpedoes (*the torpedo*) of reputed certainty of action have been rather unfortunate when the opportunity for proving success *in action* has been presented. But rapid fire and machine guns, of whose unfailing mechanism and absolute precision so much has been boasted, do not always sink torpedo boats, and sometimes *jam* or get deranged at the very moment when the greatest dependence has been placed in them. The crucial test for all weapons is made only on the field of battle. Instances of the truth of these deductions may be found by the perusal of the accounts of any of the naval actions where the Whitehead torpedo has figured. The experience of the French in 1870 with their machine guns has caused the blame of more than one lost action to be attributed to the undue dependence placed upon them. Again, the more recent machine guns used in the Soudan by the English gave great cause of complaint.

We come now to the consideration of the torpedo as a weapon, unhampered, to a certain extent, by the too complete submission to so-called facts. It is generally conceded that the torpedo—automobile, self-directing, and self-firing—will be a most prominent factor in all future wars. Even if we look at the modified type now known and used in this country, it must have a place in the front rank in any defensive operations, and will not be found wanting in

the offensive. With us, the spar, with the mine on its end fired by electricity, has been so perfected that it is not to be despised, and when borne in suitable launches, it will doubtless do effective service.

The torpedo has been called by a well known Englishman "the weapon of the feeble," and it is undoubtedly a great leveler. But while it promises to exercise great power physically, it should not be gauged by this consideration alone. Its greatest power lies in its immense moral influence. It is herein that may be based its claim to be one of the most potent agents of the day. No admiral exists who would venture to anchor his fleet off a port where swift torpedo boats are known to be, and lie there without other protection than his picket boats, his search lights, and rapid-fire guns. His safety depends on his mobility, and to lie off the port will involve a destruction of this power of moving, in that he must so surround himself by nets and booms that he himself destroys his mobility. Such a view was doubtless had by Captain Fitzgerald, R. N., who, in a recent discussion, expressed the opinion that "the torpedo will prevent blockading by making it inadvisable to anchor or lie within the cruising radius of torpedo boats." The torpedo has caused a movement which foreshadows the abandonment of the ironclad. The energies and inventive powers of naval architects are strained to devise some plan to make the vessels of the day unsinkable, and the tendency to insure this will work injury to speed, that great desideratum. There is no consideration as to the building of ships of war, or the fighting thereof, into which the possibilities of the destructive effects of the torpedo do not enter and become the greatest factor.

When compared with the two other great weapons, we must yield the *first* place to the torpedo. As to the ram, we believe the torpedo has caused it to take second place. This view, taken by many prominent officers of foreign navies, is so clearly stated by Capt. Colomb, R. N., that we venture to quote his words: "I think the effect of the torpedo is to push the ram back almost if not entirely, for I cannot conceive anybody attacking with the ram if he can attack with the torpedo instead."

Now let us consider the gun for a moment. As ships are now built, their destruction by artillery fire will be a most difficult operation. The most perfect guns, while capable of long ranges, are not considered as being at their best unless within comparatively short ranges. Careful estimates give the proportion of hits from modern guns at about 25 per cent at 1000 yards. One in four is not much

as against a well appointed ship commanded by a brave man who insists upon pushing ahead at great speed, notwithstanding artillery fire, until he gets within torpedo range. The torpedo will keep the ram at a respectful distance and defy the gun.

To sum up this comparison between the gun, the ram, and the torpedo, we think the *first* place belongs to the last-named weapon. Vessels are armored to resist the attacks of the one, and may be so skillfully handled as to avoid the onslaughts of the other; but this silent foe speeding beneath the waves cannot so easily be avoided. It may fail occasionally—it will, perhaps, fail frequently—but it will succeed at times, and when one of these easily built and comparatively inexpensive weapons does strike, the effect will be something to remember, and the moral influence on the personnel of an enemy will be long felt. Machine guns can do no harm to this hidden missile. Judged by its real effects as shown in the scanty and widely separated instances when used in actual warfare, this weapon is worthy of respectful attention. No vessel of the new navy should be unprovided with auto-mobile torpedoes and the means of firing them in any direction. Experiments of the most comprehensive nature are needed to determine the best means of their discharge from ships. Emphasizing the claims of first place for the torpedo, we now pass to a consideration of that form which we should adopt in our service.

II.

CHARACTER OF THE TORPEDOES AND TORPEDO VESSELS REQUIRED FOR THE NAVAL SERVICE OF THE UNITED STATES.

The Torpedo.

There are many torpedoes now before the public. Their mechanisms are as different as their names. Nearly all are constructed to run beneath the surface, and it is claimed that good results either have been or will be attained by each and all. Without indicating any preference, we may mention a few that have and do claim attention, viz. the Lay, Lay-Haight, Berdan, Sims, Paulson, Howell, Hall, Patrick, and the Whitehead. Specific claims are advanced in each instance, and many trials have been made, with varying success. Experiments are in progress now with the Howell, Hall, and Patrick torpedoes; these are of American invention, as indeed are some of the others named. Future developments are anxiously awaited, pending which we must turn to the torpedo now most widely known.

The Whitehead torpedo will hardly need a description. It is a torpedo as defined, and this weapon, or something as good, or *better*, is what we are awaiting. This torpedo has been before the public for nearly twenty years, having been first experimented with in 1868. Nearly all nations having navies have purchased its secret and have provided themselves with the torpedoes in greater or less numbers. Since its origin, many improvements, both by its inventors and by the English, have been made. Greater speed and certainty of direction have been secured during these years, and to-day it is claimed that it has been so far improved that it possesses the element of great certainty within somewhat limited ranges. An immense gain in speed has undoubtedly been attained. The Admiralty official reports of exercises with the Whitehead go to show that during the past three years as large a number of hits has been made as 75 per cent for a general average. In some of these years the number of trial shots, from which this showing is made, amounted to 1000. It is true that the target was at rest and two hundred feet in length, and it is presumed that the circumstances were all favorable; but even if we throw out a liberal percentage due to the various features of an engagement, such as the motion of the target, movement of the firing platform, possible deflections by bow wave, and last, but not least, excitement of the men who are working the torpedo discharge, still, in the face of all this, we may not be far wrong in stating the possible hits during an action under ordinary circumstances—injecting the supposition, however, that we have trained men—to be about 30 per cent, which would be sufficient to disable, perhaps destroy, a certain number of the opposing ships. We are forced to the conclusion that so far as results have been shown, meagre though they be, in actual warfare, this weapon stands without a rival among torpedoes at the present writing. But it must be remembered that when it has had an opportunity it has failed, from a variety of causes, to score those brilliant successes that those who used it had a right to expect. Let it be borne in mind that we do not advocate this torpedo as a perfect weapon. It is the best known, most generally used, and the *only* one of its family that has ever seen actual service, hence it is used in illustration.

The Whitehead was first used by H. M. S. Shah against the Huascar, May 29, 1877. The results were unsatisfactory. During the war between the Russians and Turks it was employed on a number of occasions with generally unsatisfactory results, although one Turkish vessel was destroyed by the Russian officers using the Whitehead.

This was at Batoum, in 1878. Two torpedoes were fired, and it is not known whether only one or both torpedoes struck; the vessel, however, sunk in two minutes. It is only fair to state that the Russians could not have been familiar with its workings, as they had no Whiteheads when war was first declared. Two were lost on one occasion during this war, and having run on shore and failed to explode, saved the Turkish Government the expense of purchasing the secret. It was reported that the firing pins had not been adjusted.

These results are not satisfactory, but such are the only war experiences with this weapon. It is true that great improvements have been made since those days, and the great faith placed in the Whitehead by the most intelligent officers of the English and other navies indicate good results from experiments repeatedly made by them. We are inclined to think that it would be well if our naval officers might have the opportunity afforded them to make exhaustive experiments with this weapon under all possible circumstances.

The effective range of the Whitehead is small as yet. It may be effective at 800 yards, but it is much more certain of effect at closer quarters; 400 yards may perhaps be stated as the range at which it may be counted on with a reasonable degree of certainty. Its speed has been developed until it is, beyond question, very great. Much has been claimed by the various competitors with this weapon, but it remains to be proven with what show of right.

The torpedo for our service is yet to be adopted, but we may be permitted to hope that in the near future it is to be developed. We who have always held the foremost place in the inventive world, and who first introduced this kind of warfare to the world, must find a torpedo wherein all of the objectionable features of this at present almost perfect weapon shall be avoided and a closer approach to perfection obtained. No stimulating agency should be neglected. A great reward for a *perfect torpedo* should be offered, open to all American competitors; but while waiting for the coming of this ideal torpedo, we submit that it would be well to be provided with "the best that can be had." We stand committed in this paper to the conclusion that we do need a torpedo for all of our new vessels, and until something better offers we should have the Whitehead.

We would sum up the requisite qualities to be found in our ideal torpedo to be: 1. Long range; 2. Certainty of action, certainty of starting on course, and certainty of explosion when contact is made; 3. Heavy charges, so that it will be dangerous even if stopped by nets; 4. Security from enemy's fire (the Whitehead is very dan-

gerous to those handling it if it be struck by a small shot even); 5. Great speed to the end of run; 6. Directing power; 7. Ease of manipulation; 8. Capability of being fired frequently for trial without derangement; 9. Maintenance of a constant depth to the end of run; 10. Noiselessness and invisibility; 11. Simplicity of construction and ease of repair; 12. Inexpensive of manufacture and not easily injured by corrosion of parts.

We now pass to a modification of the torpedo which we already have in use, and which we think it necessary to retain as part of the equipment of every man-of-war flying the pennant, namely,

The Spar Torpedo.

All vessels of war in the U. S. Navy are furnished with the cases, spars, and electric outfits for such of their boats as are adapted for this work, *i. e.* steam launches and cutters. Spars or booms are fitted to the ships themselves, and cases are provided, suitably stored, as are also the electric plant and connections.

As regards the efficiency of these spars or booms attached to slow going modern ships, except as a defensive weapon, we have nothing to say, but as regards the usefulness of the spar or outrigger carried in steam launches of a good type, and the advisability of retaining them, we think there can be no doubt, and we are fully prepared to believe that the brilliant successes achieved by Cushing, handicapped as he was by a cumbersome boat and crude firing apparatus, as against the Albemarle with its outlying protective boom, can and will be accomplished by our officers again. The light running and noiseless steam launch of great speed, bearing perfected machinery for handling the boom, and a case containing an explosive, dangerous only when made so by him who commands, fired by a simple touch on a key, are as great gains for the offense as are the steel hawser, rapid fire and machine guns, and the electric search light for the defense.

It has been said by Commander Sleeman: "It (the spar torpedo) has the advantage . . . . that it always carries *with it the intelligence* of the officer in command up to the very last instant of attack." This is an element too often lost sight of. Here will be no uncertainty as to the cause of failure or success. Of course, many things may conspire to prevent success, but the man is there to adopt one expedient after another before yielding and confessing defeat. In connection

with this subject, although not wishing to cite the incidents as of a convincing nature, we would call attention to the account of the French operations on the Min river by M. Chabaud-Arnault. He says: "On the 23d August, 1884, two torpedo boats armed with spar torpedoes passed from the unexposed side of the French ships and succeeded in destroying two Chinese gunboats, the Yang-Woo and the Foo-Poo, in broad daylight." Again: "Two Chinese ships were attacked in Sheipeo Roads, 15th February, 1885. The boats carrying the torpedoes (spar) were small and slow, but they succeeded in finding the frigate Ya-Yuen and sunk her." In the first case no resistance seems to have been made, but in the second instance the boats received a number of shots, one 11, the other 6, and one petty officer was killed; the shots did, however, but little damage to the boats. In both cases the spars got foul of the enemy's ships, and were cleared only after great difficulty and exposure to great danger. The French naval authorities since these experiences have ordered complete spar torpedo outfits to be supplied to all ships in commission. Sir Thomas Brassey, Naval Annual, 1886, says, speaking of spar torpedoes as used in connection with "Defense and Attack of Portsmouth, 1880": "Those who saw the steam pinnaces driven at full speed over the booms will probably be of the opinion that for such use they were better adapted than fragile torpedo boats." This matter of the fragile character of the smaller torpedo boats will be spoken of further on. Admiral Gore Jones, R. N., citing some American experiments, commends the value of the spar torpedo shown by work done by the Intrepid and the Alarm on several occasions. He emphasizes the fact that *mind* was brought to bear and the torpedo was "exploded at the exact spot." Now, although these opinions were the expression of impressions formed a few years ago, it must be remembered that then speeds were slow as compared with what is possible now, and if the rapidity of motion in the target lessens the likelihood of being struck, then the spar torpedo gains by the fact, and what was then remarked upon favorably would probably be within the possibilities now, notwithstanding rapid-gun fire.

Against the use of this form of weapon, as also against the use of any torpedo boat, has been urged the great influence of the electric search light. While it is true that this light is very powerful as a spotter of the boats, it will be remembered that its use before an attack will hardly be resorted to, for by its use one of the principal difficulties of a torpedo attack will be obviated. It is not easy to find

vessels at night, whether at anchor or under way, when as a precautionary measure all lights on board are carefully concealed from view, and this is true whether the night is dark or only partly so. Many instances might be shown of the difficulty encountered by boats in finding ships known to be at anchor in the neighboring waters. The imprudent use of the electric light will solve this difficulty for the boats. Besides, the light affords a most excellent target, and the attack would perhaps consider it of sufficient importance to have one of its larger vessels with the boats or near them, having the destruction of this light as its object. It is not advanced in behalf of the spar torpedo that it can do impossibilities, but it and the torpedo should both be in the hands of our officers. As an adjunct to a harbor defense it will be invaluable, and as a weapon to have at hand on shipboard ready to strike at an enemy under favorable circumstances, we are convinced that it is of great use.

Having thus endeavored to show that we need a perfect torpedo, and also that it will be advisable to retain and improve our old friend, the spar torpedo, we will pass to the next subject for consideration, *i. e.*, the boats to carry them.

Torpedo Vessels.

a. Torpedo boats, 1st and 2d class.
b. Submarine boats.
c. Launches to carry spar torpedoes.
d. Torpedo supply and repair boats.

Torpedo Boats.

In nothing has a greater diversity of opinion been manifested in naval circles in all parts of the world than on this subject. Each year sees some innovation which is readily grasped as a realization of the ideal, and for a while holds its place as a complete solution of all the difficulties of this complex question, but it is soon superseded by some other device which is to do still greater things. At no period of naval history has there been so much credulity evinced; any innovation is seized upon with almost feverish haste. This is hardly to be wondered at when one looks at the wonderful changes since the introduction of iron and steel in naval construction, the coming of the torpedo, and the general use of electricity. From the multitude of typical vessels, many of them consigned to the oblivion of the "rotten rows" of all navy yards, we may draw many lessons and

avoid, perhaps, many mistakes. As we understand the wants of the U. S. Navy, there will be two classes of torpedo boats needed. One, the 1st class, good sized vessels, fairly protected, suitable for sea duties; the other, much smaller, for duties in enclosed waters and in connection with harbor defenses.

The qualities requisite for 1st class torpedo boats will probably be as follows: Speed is of course of the very first importance. Size sufficiently large to be able to keep the seas; with ample accommodations for the officers and crew, and storage capacity for coal and provisions. Reasonable protection from machine and rapid gun fire. Minute compartment subdivision to render the boat as unsinkable as possible. Draft of water, so light as to enable the boat to get into the most important harbors on the coast. Great handiness in turning and reversing. Armament capable of resisting an ordinary attack when torpedoes are expended. Comparatively great coal endurance.

Naval architects point out that in designing ships some of the desiderata must be sacrificed if we wish to develop abnormal qualities in a certain direction. Up to a very recent date everything has been sacrificed in the endeavor to obtain great speed, and now we have come to a period when other essentials are pointed out and recognized as important features.

Much stress was laid upon the fact that the torpedo boats ordered to assemble in Toulon for the evolutionary squadron in 1886 succeeded in making the voyage from Brest to Toulon; but if the accounts are carefully studied, it is seen that this result was obtained by dint of the utmost care and watchfulness, and caused the complete exhaustion of the crews, composed of men picked for the purpose. The experiences of the English squadrons at Bantry Bay proved the inexpediency of sending the torpedo boats to cruise with the fleet.

Now a boat that has all she can do to live in a sea is not a very dangerous antagonist, and as the sea is rough at times, the small nutshells heretofore known abroad as 1st class torpedo boats could not be counted upon with any certainty. A modification of this class of boats, however, will be exceedingly useful in the defense of our coast and harbors, or in offensive operations near their bases and within certain limited circles. A radius of 60 miles is suggested as within the possibilities of our smaller (2d class) fast torpedo boats. It is generally conceded in England that defense by submarine mines must be supplemented by torpedo boats, or else such defense will be

weak. That this is recognized in our country is shown by the recommendations of the Coast Defense Board, who include torpedo boats as necessary adjuncts to all proper harbor defense. Indeed, a port with the peculiar features of San Francisco can only be defended by guns and torpedo boats. Such vessels as those now called torpedo hunters and torpedo boat catchers, we will drop from consideration. They are swift men-of-war with many torpedo discharge tubes, and do not come under the same head as the vessels under discussion. In many cases it may be difficult to decide just where the torpedo boat ends and the hunter or catcher begins, so nearly are some allied.

A review of a few of the more recent constructions coming under the head of sea-going and sea-keeping torpedo boats may not be out of place. Those named are somewhat like the 1st class torpedo boat which will be advocated here. As typical vessels we cite the two torpedo boats built in England in 1885 for the Austrian Government, the Panther and the Leopard. Their excellent sea-going qualities have been proven. These vessels are intended for service as torpedo cruisers and as rallying points for the smaller torpedo boats. They are unarmored rams, with a speed of 18 knots, 225 feet long, 1570 tons displacement, 4000 I. H. P., armed with two 5″ Krupp B. L. and 10 machine guns. In France the Condor class are somewhat similar, being 216 ft. long, 29¼ beam, 1300 tons displacement, estimated speed 17 knots, armament 5 10-cm. guns, 6 machine guns, and two torpedo tubes. The building of these vessels led to the ordering of the Scout class in England, of about 225 ft. length, 19 ft. draft, 1430 tons displacement, I. H. P. 3200; having twin screws and triple expansion engines, and eleven torpedo discharge tubes. There is a protective deck of steel ⅜ in. in thickness over boilers and machinery. Seven of these are being built. A second type is known as the Grasshopper type and includes the Rattlesnake, Sand Fly, Spider, etc. They have steel hulls, displacement 450 tons, I. H. P. 2700, 200 feet in length, 23 ft. beam, draft of water only 8 feet, speed 19 knots; engines, two sets of triple expansion of the vertical type, four locomotive boilers. They have ¾-in. plating on sides to protect boilers and machinery. Armament, 4 torpedo tubes for Whitehead torpedoes, one right ahead, one astern, and two pivots amidships; one B. L. 4-in. gun, six 3-pdr. rapid fire guns, crew about 600 men. These boats are to carry 100 tons of coal for 600 knots at full speed, or for 4000 knots at 10 knots per hour. No rig

except two light poles for signal purposes. Cost about $175,000 each. Still another boat which has attracted attention is the White turn-about boat. "These boats have their dead wood removed in order to obtain facility in turning, and are fitted with an inner and outer rudder, simultaneously actuated, either of which would suffice to steer the vessel in the event of the other being lost or disabled. Length 150 ft., 17 ft. 6 in. beam, 9 feet 6 in. deep, displacement 125 tons, built of thin steel plates, conning tower amidships. Speed on measured mile, 20.79 knots. When running at full speed they can be brought to a full stop in a few seconds." These boats show remarkable handiness in turning A new boat built by Thornycroft & Co. for the Spanish Government—the Ariete, a twin screw boat, 147 feet long—has attained a very high rate of speed, over 26 knots! Yarrow & Co. have just built for the same government two fast boats of the smaller class, 135 feet long—the Azor and Halcon.

It is, however, to the Leopard, Scout, Condor, and Grasshopper types that attention is particularly called while on the subject of the 1st class torpedo boat proposed for the U. S. Navy. These are all sea-going boats, and are useful in peace as well as in war. The general tendency everywhere is toward larger boats and better protected ones. The speed requirements seem to have attained a satisfactory point, for the tendency is now toward a recognition of the fact that too much is being sacrificed to speed, and the endeavor is in the direction of securing more trustworthy vessels and adding protection against the rapid fire and machine guns. The necessity of this will be shown if ever torpedo boats meet in actual war, and this refers not only to strength of hull but also to machinery protection. It is pointed out in the Report of the Secretary of the Navy of this year that the Japanese have taken a step in this direction. They have just had a boat built 166 feet long, with boiler and machinery protection of 1-inch steel armor.

In the United States several boats of small size have been put into the water by the Herreschoff firm, mainly with a view to develop speed. The Now-Then is only 86 feet long. She has triple expansion condensing type engines, and has attained a speed of 23.2 knots. Such a vessel, if properly constructed for war purposes, would meet some of the requirements for our modern 2d class torpedo boats.

Having glanced hastily at what is being done by others, and keeping in view what we require on so extended a coast as ours, with oftentimes heavy weather to contend with, we would venture to

suggest that the U. S. torpedo boats of the 1st class should have the following characteristics: Length, 200 feet as a minimum, 22 feet beam minimum, 14 feet draft of water maximum; to be ram-bowed; to have twin screws; 2 independent engines of triple expansion condensing type, using forced draft; boilers in separate compartments; reserve coal to be carried as a protection abreast the engines and machinery; to have numerous compartments and a longitudinal bulkhead; protective deck over boilers and machinery of at least $1\frac{1}{4}$ inches steel; greater beam may be given to allow of the coal protection, it being well known that coal is a great stifler of the explosive effect. This boat should be provided with at least four torpedo tubes, so that torpedo fire may be had ahead, astern, and on either bow and either quarter; the latter to be worked in pivot. These firing tubes, as well as the guns, should be placed under dome-shaped protection, or a turtle-back of at least $1\frac{1}{2}$-inch steel plating. The conning tower should be of 3-inch steel plates, and built up independent of the "tube" protection. Her armament should be 4 6-inch rapid fire guns, 4 Hotchkiss revolving cannon, and 4 Gatling guns, so disposed as to secure all-round fire; speed about 18 knots with service weights on board. All torpedo boats of the 1st class should be furnished with the search light. Such a vessel would have ample capacity for coal and provisions, and her accommodations would afford fair comfort for her officers and crew. A vessel something like this would combine the features of a 1st class torpedo boat with those of the so-called torpedo hunters or catchers.

The 2d class boats should be of greater speed, less draft of water, less solidly constructed, less coal capacity. A light protective inclined deck should cover the vital parts. One requisite would be that they be built stiff enough to stand hoisting on board and lowering, if that be contemplated, but mainly that they may be capable of standing railroad transportation, as that *would become* a very important consideration in our country, particularly if it were desired to concentrate on the Lakes, for instance. Recent experiments in France have demonstrated the feasibility of such transportation. The carriage of these boats on battle ships is not seriously contemplated. It is done in foreign navies, and numerous devices are adopted for getting them into the water with safety and despatch, but it seems that the lowering and hoisting of such frail-sided constructions of great length, built in many instances of plates only $\frac{1}{12}$ of an inch thick, will be attended with the greatest risk to the boats and their delicate

machinery. In a seaway the boat would either be crushed against the ship or swamped alongside. Torpedo boats, whether of the 1st or 2d class, should be independent, and if not injured by an enemy, should be able to take care of themselves before, during, and after an engagement. Guns of 100 tons have been transported by rail, and torpedo boats of the same tonnage (2d class) could be also.

Should it ever come to pass that the United States possessed a flotilla of first and second class boats, the necessity will arise for torpedo depot ships, floating shops for repairs, and storehouses from which torpedoes and torpedo stores may be supplied. Those who served during the Rebellion in the then new types, the monitors, will realize how advisable something of this kind will be, when they recall the workshops for repairs that it was found necessary to establish in the immediate vicinity of the monitor fleet off Charleston. These torpedo depot ships would visit each station in succession and would be found of immense service. Boats at Key West or New Orleans would find them welcome visitors. These vessels must needs be large, of great beam to ensure great carrying capacity; good speed, say 15 or 16 knots; fitted with torpedo tubes for defense and to permit tests; protective deck, large numbers of rapid fire guns, and net protection, in order to resist torpedo attacks. A large space would have to be allotted as a workshop, and she should carry duplicate parts of machinery for the torpedo boats, as well as spare outfits for the spar torpedo.

It may not be out of place to suggest that when we decide upon a torpedo boat that shall be found to answer all requirements, all the boats should be built alike, so that spare parts may be constructed and kept on board the depots. The experiences of the late civil war would serve to show the inexpediency of a multitude of types. Vessels of the blockade were continually coming to a navy yard, and while there their services were lost to the country. If the torpedo boats are to be kept in a serviceable condition on their stations in time of war, then the depot ship seems to be a prime necessity. Experience will teach us the best class of materials for these boats.

In closing the remarks on the torpedo boats it is not out of place to call attention to the usefulness of a fast boat of the 1st class as a despatch boat for the Admiral during an action, and also that in the designing of the 2d class boat it must be remembered that she must be able to enter any of the numerous coves and inlets along the coast in the immediate neighborhood of her station, and that there-

fore she must not draw much water. Her salvation may depend on being able to go where an enemy dare not follow.

Submarine Boats.

General attention is being drawn to this class of boat at this moment, and as we are treating of new types we will consider this as coming within our scope. Ever since the days of Bushnell and Fulton, attempts have been made to solve the problem of under water navigation.

The history of submarine boats, until within a very recent date, has been one of failure and disaster. The Russians have made many experiments in this direction, but are not known to have acquired any marked success. The Rebels succeeded in constructing a submarine boat which finally destroyed the Housatonic, but the lives of the destroyers were sacrificed, as the boat sank by the side of her victim, and thus lost her fourth crew, having failed to come to the surface on three other occasions.

In this country a submarine boat has recently promised good results, and in Europe the Nordenfelt has been successfully operated and it is said to be a good type. The construction of a boat of this class having been authorized by Congress, invitations for plans have been made, and we may expect to see some interesting models. The Nordenfelt launched in March, 1887, is the largest boat of this class ever attempted, being 123 feet long, and her displacement when wholly immersed is 243 tons. If this boat can do all that is claimed, then is our labor in vain and the building of ships may as well be discontinued, but we cannot forget that Bushnell and Fulton were no less confident of success. Many points will have to be settled before this problem is solved; for while it is not doubted that boats can be and have been constructed to move below the surface of the water and remain there for varying periods of time, still the question as to the effect of the explosion of the torpedo upon the submarine boat will have to be settled.

It may be suggested that if steel nets will keep out a Whitehead torpedo they will also keep out a submarine boat. All that the battle ship will have to do, if forced to anchor in hostile waters, will be to "come to" in as shoal water as may be consistent with safety and lower her nets until they touch the bottom. Whatever novelty is developed by the offensive will find a corresponding novelty devised by the defense. The use of the electric light below water, recently

experimented upon at the Torpedo Station in connection with countermining, may suggest its possibilities as an illuminator of the subaqueous field; and once a certain zone of light is established about a ship below the surface, an easy mode of disposing of the submarine terror will be the attack from directly overhead. These are mere suggestions, and while we are willing to regard the submarine boat as a possibility, we can hardly rank it as a probable success. Nordenfelt's boat, moving just below the surface, with its cupolas just awash, presenting a minimum of surface exposed to view, while permitting intelligent direction and the admission of air, seems feasible, and a dangerous opponent to grapple with, but once below the waves, it will be no easy matter to find a ship rapidly changing her position.

Steam Launches to Carry the Spar Torpedo.

These boats should be strongly built and as large as possible consistent with the capacity of the ships carrying them. Steel will perhaps be used in their construction as giving a maximum of strength with a minimum of weight. The engines should be powerful and noiseless, and have provision made that there be no flame visible at the smokestack at night. It is to be regretted that the petroleum launches experimented with a few years ago could not have been perfected, for in them no smoke-pipe was needed. It is equally to be deplored that the electric motor has not developed, as yet, sufficient power to drive these boats at any high speed. The reason for the anxiety to do away with the funnel is that experiment has proved that when used as torpedo boats, sparks from the launch's funnel betrayed her before she was heard or her neighborhood otherwise indicated, and again it is a fact that the first thing the electric light detects in an approaching boat is the escaping steam.

Any *white* object is rendered particularly prominent by the search light. It has been found expedient to paint all objects on the boat a dead black, even to the faces and hands of the men, if an attempt to approach a vessel is made in the face of an electric light. The launch as perfected and armed with the spar torpedo is presumed here to do away with the necessity for carrying the so-called second and third class torpedo boats now crowding the decks of the battle ships. In the launch we have during the time of peace an efficient and useful boat for all ship's purposes, readily lowered in any ordinary sea, of great capacity for carrying men in the event of a fatal accident to the ship, and withal a good serviceable boat when fitted for war purposes.

We want good strong boats of great capacity and of first class sea qualities. We do not want phenomenal speed in boats that are to carry the spar. No boom would long stand the strain upon it, and besides it will be advisable to fire the torpedo with engines reversed, lest we be "hoisted by our own petard." No complicated machinery should be fitted up for the handling of the boom—that furnished at present seems all sufficient. Provision should be made for the complete unshipping of the boom at once if it should become fouled alongside an enemy.

The largest launch of 1st class vessels should, perhaps, be fitted with a tube to fire a *torpedo*, but it, as well as all others, should carry the spar torpedo. The superiority of the launches for attacks on booms or other obstructions has already been pointed out, as compared with the "fragile torpedo boat."

If possible, the engine and boiler should be placed well aft, leaving the working space forward. As the launches are built to-day the officer cannot get forward quickly. This is a very important point to be attended to in the building of the new boats. Let the engine and boiler be aft and as low down as possible, then the officer and the crew will all be together in the fore part; all work can be done silently, without the necessity of "orders"; the wheel is there, and, moreover, greater space will be obtained to work either the torpedo and its tube or the spar torpedo. It may be possible to devise a *hood* of $\frac{3}{4}$-inch steel to form a shield for the steersman and men handling the torpedo, or, in fact, for general protection. This hood could be made to be shipped when equipped for action, and might be unshipped when the boat was used as a working boat.

The danger apprehended by many of being easily sunk by machine gun fire in one of these thin-shelled boats is not so great after all. Even if pierced—a small hole—the rapid movement will prevent the water from entering in any great quantity. Some degree of risk will attend every encounter of the future.

It has been said: "In all discussions of the present day the most important factor seems to be left out; weapons are discussed and their potency pointed out most clearly, but *man* and his individuality have been lost sight of." It is in this light that we urge the claims of properly built steam launches as against the very small torpedo boats. The launch is to be the better sea boat, and could be employed in night attacks when too rough for very small boats—we refer here to boats carried by ships—torpedo boats, so-called.

There is some comfort in the launch, there is every discomfort in the torpedo boat. Even the toughest men of the English and French navies suffered from seasickness; no food could be prepared for days, and herein comes the consideration of *man.* No man having once had this experience will subject himself to it again. In ordinary circumstances of weather, and given the most remote chances of success, we believe men generally would prefer to serve in the ship's launches rather than in the ship's torpedo boats. As part of the equipment of steam launches' crews for torpedo attack, the officers and men should be provided with a jacket to be worn while in service, made of webbing or light canvas, and lined with cork, or quilted in with the same, so as not to be cumbersome and so prevent the work being rapidly done. This jacket or vest would not only be a life-preserver, but would act also somewhat like an armor as against small missiles. If these pages contain matter of a somewhat speculative nature, it may be urged that, until we have had larger experiences of our own, the whole subject must be *somewhat speculative.*

III.

ORGANIZATION OF NAVAL TORPEDO SERVICE AND INSTRUCTION OF ITS PERSONNEL.

The organization of the Confederate Submarine Battery Service in 1862, during the War of the Rebellion, was the first instance of an attempt to secure the services of trained officers and men whose duties were to perfect themselves in this class of warfare, to devise and experiment with all such weapons, and to use them finally in the face of an enemy. M. F. Maury, of the old navy, was made chief of the Torpedo Bureau, headquarters at Richmond. He selected officers with whom he had been associated in the U. S. Navy and with whose abilities he was familiar. These officers were a nucleus about which was soon formed an efficient corps. The status of this corps was fixed by an Act of the Confederate Congress. The officers organized and drilled the men. The men were sworn to secrecy, and had good pay and many privileges. Submarine mines were at once laid in all the principal harbors, and offices were established in the cities near by. Drifting torpedoes were devised and sent down the currents, and when the torpedo boats of various designs came to be known, this corps first tried them and then manned and worked them. All reports from subordinate officers were made directly to the chief of the bureau in Richmond.

In England the torpedo service is not as yet clearly fixed. Officers and men are instructed and drilled, both in the army and navy, but it is not as yet systematized. It is generally understood that all submarine mine systems, being under the protection of the forts and being connected with them, are in charge of the Royal Engineers. It is also claimed by the officers of that corps that not only the mines and forts, but also the *torpedo* boats for harbor defense, should be in the hands of the commanding officer of the harbor defenses. However this may be finally settled, it is certainly very important that there should be no clashing of opinions at the critical moment. The Confederate service owed a great deal of its success to the fact that only one chief was to be consulted and his orders were final. M. Gabriel Charmes tells us that in France: "We have at Boyardville an excellent school for our officers, and the torpedo school ship Japan graduates mechanicians of the utmost skill. . . . . It is wonderful to see them exercise: these schools furnish us with personnel of the first order."

As in England, so it is with us at present. The system of submarine defense of a harbor, with the mine field covered as it must needs be by the guns of the fortifications, and with its firing system led by galleries to within the fort, must be entrusted to the engineer corps of the army, as also would be those torpedoes designed to be fired from the shore. All movable torpedoes, except as before noted, and their carriers, should be in the hands of the Navy Department or some bureau thereof. Both in England and in the United States the rank and file of the engineer corps is wholly inadequate, in point of numbers, as at present constituted, to give proper attention at each harbor. In England the formation of a volunteer torpedo corps has been urged as a means of solving these difficulties.

The organization of a naval torpedo service should be effected, and that at once, and its status should be fixed by Act of Congress, so that its existence may be legally established as is that of the artillery or engineer corps of the United States army. The personnel of such a corps would have to be most carefully selected at first, so that intelligence might establish rules based upon common sense, and be liable to such changes only as may be caused by the change in the weapons from time to time. It is suggested, therefore, that an officer of high rank, not below the grade of captain, and of known abilities, be selected as chief of the Torpedo Corps, U. S. Navy, whose office should be established at the Navy Department,

Washington, D. C.; the Secretary of the Navy to be his only superior as far as the duties of his office are concerned. The office should be provided with proper assistants and clerical forces. We would add further officers as follows:

Four Commanders—as chiefs of sections, these sections being geographical divisions of the coast, arranged in somewhat the same manner as the lighthouse districts, having their offices at the principal city of their sections.

A number of intelligent lieutenants, of both grades, and ensigns who have had the benefit of the Torpedo School instruction, should be detailed to this corps, to be assigned for service in all ports and harbors where torpedo-boat defense has been recommended by the Board of Coast and Harbor Defense. It will be the duty of these officers to instruct and drill the men who are to be enlisted, having frequent and complete exercises with the torpedo boats and spar torpedo.

As to the proposed division of the seacoast of the United States into "sections" over which the commanders are to exercise control so far as torpedo service is concerned, it is proposed, for the sake of illustration, that it be as follows:

1st Section.—Maine to New Jersey, including the Lakes.

2d Section.—New Jersey to the southern end of Florida on the Atlantic coast.

3d Section.—Gulf Coast and the Mississippi.

4th Section.—The Pacific Coast.

The commander of a section will have charge of all torpedoes, torpedo boats of 2d class, and all launches and spar torpedoes which may be assigned to the ports or harbors of his district. He will frequently inspect the boats and stores and will attend exercises. The boats are to be commanded by one of the junior officers attached to the harbors, and are to be manned by the torpedo corps detail stationed there, with such assistance as will be suggested further on.

As all of these officers, except perhaps the chief, will be required to do their usual sea duties, one commander and one fourth of all juniors may be made available for sea service each year, their places to be filled by new details, drawn as far as possible from the class under instruction at the Torpedo School at Newport, as these generally are but recently from sea duty. At present 100 men might be sufficient. They should be young and intelligent seamen drawn from

the Apprentice Corps, and available only when they shall have completed their term of service as apprentices. These men should be selected with a view to make of them a permanent corps, being drilled most thoroughly, step by step, into a perfect understanding of the practical workings of whatever boats and torpedoes are finally decided upon. These men are not to be drawn into the general service under any circumstances, and will not be detailed for duty on board men-of-war, except only when ordered by their bureau to perform certain *torpedo* service under their own officers. As they will have great responsibilities, and must bring with them a high degree of intelligence, they should be treated with consideration; and certain privileges, good pay, and a system of promotion, should be incentives to study and to strict attention to duty. Their enlistment in the Torpedo Corps should be for a long period, and it may not be, perhaps, too much to propose that those who distinguish themselves by unusual qualities might be promoted after proper examinations to be commissioned officers, beginning with the position of 3d Lieutenant, Torpedo Corps. A certain number of these torpedo men should be permanently located at the ports of the section where torpedo depots are to be established and boats maintained.

The establishment of a permanent torpedo corps does not do away for a moment with the necessity of torpedo instruction and drill on board ship. The system of sending officers from this duty to sea will ensure an efficient body of instructors in the various squadrons.

Carefully revised manuals of torpedo drill and torpedo tactics should be prepared by the Torpedo Bureau, and officers trained at the Torpedo Station, perhaps fresh from practical work in the torpedo corps, will be on board every ship in the service and must be detailed to instruct. The system of study and all the requirements necessary to the receipt of a *Torpedo Diploma* or Certificate will be settled by the Torpedo Chief with the approval of his superior, the Secretary of the Navy. The Torpedo Station, as well as everything pertaining to this service, should be in charge of the Torpedo Bureau.

At first glance it might seem advisable that some of the torpedo men should be detailed to the general service, but we have, after due reflection, avoided that, as herein lies one reason why men do not care to take the long and tedious course, *i. e.*, the possibility of being drafted for general duties. As it is now, when a young man who has completed his service as an apprentice and is ambitious re-enlists

and obtains detail to the Torpedo Station with a view of perfecting himself in that branch, or is sent to Washington to study in the Ordnance Yard, he has no guarantee that he will not be called upon at any time for service afloat, and when he goes on board ship he finds himself very often assigned to duties entirely foreign to those for which he has been educating himself.

We assert again that the formation of the proposed corps in no way prevents the regular torpedo drills and exercises on board ship, but should rather have a stimulating effect, and such officers and men as, while on shipboard, were distinguished by their aptitude for this work and application to the drill, would find a detail to the corps awaiting them when the cruise was over. All reports of torpedo exercises, all torpedo receipts and expenditures will be reported to the bureau by the officer who may have been designated as torpedo officer. All such reports would, of course, go through the regular channels as now established.

As a further and most important feature in the organization of the Torpedo Corps, we desire to fix attention on the fact that this small body of 100 men is a nucleus only; for, of course, many more must be added, and this may be effected in the following manner: Suppose we have now this body of 100 men divided up into squads of ten men each, and they and their particular officers are established at Portland, Boston, Newport, New York, and so on. They pursue their drill and attract attention, particularly amongst those men who frequent the waters of the harbor,—and it is just these whose attention we wish to attract. It is important that we should enlist in each port a certain number of young Americans who have been born near the harbor and whose families have been waterside people.

Fishermen and "coasters" are the men we shall need. Their knowledge of the bays, rivers, and inlets, and of the currents and tides of their particular localities would be most valuable. It will be the object and aim of the officers and men to interest young watermen in the corps, and by good pay and good pension provisions the services of this class could be secured. A special uniform should be adopted, and the assurance of permanent employment, when once properly qualified, near their homes, will have the effect of making men connect themselves with the corps. The possibilities of promotion should be held out for distinguished attainments or services. Once this home corps of torpedo men is established, the original men will be advanced to the more responsible positions; as, for instance,

depot storekeepers, commanders of boats under ordinary circumstances, etc. There must be certain leading men, and they may be named mates, coxswains, or sergeants as may be decided upon, and their pay must be higher than that of the private. By this means it is believed that a corps of efficients would be gradually built up and would perhaps be in working shape by the time the new boats and torpedoes were ready for use.

In the event of war, which would necessitate the calling in of great numbers of officers now on detached service, it is not improbable that 1st class torpedo men would in many cases take temporarily the command of the harbor boats.

The growth and efficiency of the Signal Service of the United States is due to a certain extent to its independent and separate character. The same may be said of the Life Saving Service. It is not necessary to contemplate the diversion of a large number of naval officers from their legitimate duties in order to form this corps, *except at first.* After a little while, only the leading officers would be drawn from the regular Navy list. There are plenty of bright young men in and about every seaport who have been well educated, and who have nautical tastes, whose services as officers could be easily secured by generous legislation. We may instance the U. S. Revenue Marine Service, now completely organized, having its school for cadets, training ships, and regular system of detail and promotion. Let it be clearly understood that we advocate this organization of civilians as officers, *only* for duties in and about our coasts and harbors. The chief and the four general supervisors will always be officers of the Navy. Torpedo boats of the 1st class, torpedo depot ships, and harbor defense monitors belong to the regular Navy and would be commanded by officers of that service. If torpedo boats are carried on our battle ships they will be commanded by officers and manned by men from the ships. It is not suggested that these torpedo officers be identified with the Navy proper; the very nature of their duties would preclude this. We here propose the rank of 1st lieutenant as the highest attainable at present. Something will have to be done. Already at a minimum, the officers of the Navy are demanded for many duties other than their regular sea duties. Shore duties have multiplied ten-fold since the close of the war. The Coast Survey and Fish Commission, Lighthouse Service, Steel Inspection and Hydrographic details, all doubtless of great importance, call for the employment of many officers who for the

time being are not working in the Navy proper. Again, the drain of men is something very heavy. With the small number allowed by law it is all that one can do to get a sufficient number to fill the complements of ships in commission, but still we have some hundreds of men diverted to the Coast Survey, Fish Commission, Torpedo Station, and Tug Service, and the time has come when, if any further duties are expected, either more men and officers must be provided for the regular Navy, or some scheme must be devised to fill these needs from outside the service.

Instruction of the Personnel.

It is to be understood that in this discussion the usefulness of the instruction as now carried out at the Torpedo Station at Newport is not undervalued, and the officers and men that it is proposed to take as the nucleus of our proposed system are presumed to have had the course there, and the officers not only the usual course but the advanced or extended course. The usual course embraces, stated in a general way:

Lectures on movable and spar torpedoes, and on mining and countermining.

Electricity, as regards its application as a motor, or its use for lighting or firing purposes.

Chemistry, as applicable to the correct understanding of the components of explosives.

The mode of manufacture, handling, storing, and the preservation of explosives, as well as their uses in warfare.

Submarine diving is also taught, as are also the use of the electric search light and the manufacture of electric and other fuzes.

The course is very complete, and experiments in electricity of the most comprehensive character are carried out, so much so as to excite the warm commendations of officers abroad. Frequent experiments are made in the use of the weapons in our possession, and new inventions are often tested at the Station. It has been thought that the time allowed for the course there might be extended, and there exists a question as to the expediency of establishing a certificate of proficiency, following, we suppose, the same general plan adopted in the English Navy.

In the same harbor, though having no connection with the Torpedo School, the Naval War College is located, and it has been the custom

to send officers from the Torpedo School, on the completion of that course, to the War College to attend the lectures there. While the one course is not intended to supplement the other, it is possible, as time goes on, that the War College may have a branch for the study of torpedo boat tactics, which is not necessarily included in the studies of a school of technique.

The instruction at the School, as far as it goes, is all that can be desired, but it is only an introduction after all, so far as the practical handling of torpedoes and torpedo boats goes, remembering all the time that we have in our mind's eye the ideal torpedo and the new boats of the 1st and 2d class. The torpedo boats and torpedoes will doubtless be at Newport for the purposes of drill, practice, and illustration; but it will not be sufficient that officers should have *seen* the torpedo fired, or have been out on a trial trip on several occasions in the boats. The officers and men of the torpedo corps must have ample opportunities to learn to know their weapons. We quote a well known English authority as conveying the idea before us most clearly: "One thing is certain, that the efficiency of a torpedo boat mainly depends on the amount of practice and experience the crew have had in her. A nation with no boats to practice with in time of peace will find but little value in the few she may hurriedly get together in time of war." Pending the arrival of the torpedoes and torpedo boats on the scene, the officers and men should practice in mining and countermining; in the use of the spar torpedo; in the study of the coasts and harbors; in the construction of torpedo charts on which all good defensive points on the coast will be laid down, together with the location of the mine fields and proposed ingress and egress channels, taken from the engineer's charts; in the establishment of depots for torpedo material, and in constructing a series of torpedo magazines; and in the use of the search light, and the electric light below water.

It may be stated that while it is conceded that mining will necessarily be under control of the army where regular fields are laid under the fort's protection, still many cases may arise where a knowledge of the subject of mining will be called into play, as for instance when it may become necessary to protect a squadron lying in some harbor of refuge unprotected by fortifications and menaced by the torpedo attacks of a hostile fleet. As to countermining, it will necessarily be a part of the education of the torpedo corps as well as of the Navy, as it will fall to them very often to force a passage and clear a way through mine fields. It is not part of our plan

to get together a party of officers and men in or near a port whose duties will be performed in a perfunctory manner and where occasional drills may be had to "cover the order"; but it is supposed that the officer will have the perfecting of his men at heart, and will do all that lies in his power to keep up the interest in the work. Steam launches should be furnished as soon as the men are detailed, and exercises had against stationary and floating targets. The men would attain great proficiency and some new points would certainly be brought out. Practice as divers in submarine work should be had, and to this end each station should have the complete apparatus. Frequent excursions should be made in suitable weather for the exploration of every inlet, creek, or inside passage until such familiarity was acquired that use might be made of this knowledge on the darkest night. When the boats and torpedoes do come into the hands of the men, they should be put to every possible test, and again it is suggested that these tests, going forward in the different ports, would develop new points of great value. Neither the boats nor the torpedoes can be laid up to be "called for" when war begins. Admiral Boys, R. N., in speaking of the Whitehead, in a discussion before the United Service Institution, says: "We are told that it is a very simple weapon and wants but little attention; my experience of it was that it was a very complicated weapon and required the greatest attention; .... that to make the 'Whitehead' torpedo a success and keep it in complete order you must love it, you must be always at it, inspecting it and cleaning it; it must not have the least detail or particle out of order." What is said here of the Whitehead will doubtless apply with equal force to any other torpedo. In the attack upon the Hecla, in Portland, England, the lecturer, Commander Gallway, R. N., states, after detailing the number of hits: "In this case we had experienced lieutenants in every boat, each officer having had a month's constant practice in the boat under his charge." Captain Fitzgerald, R. N., already quoted, said in this discussion: "They are most complicated weapons; not only the torpedoes, but the boats themselves. .... Anybody might be told away to go and attack an enemy; it is a thing that requires immense practice. I am told if you put the engines on to full speed she jumps from under you like a horse, and it requires a great deal of practice to be able to sit her, let alone work her." Again, Captain Harris, R. N., in his very able paper, says: "It is a great mistake to suppose that a lieutenant taken from the bridge of a large ship and placed in

charge of a swift torpedo boat will at first be able to make efficient use of her. Not only must he have time to get used to the peculiarities of these boats, their rapid loss of way when stopped, the quickness with which they acquire a high speed when the engines are started, but he must have time to overcome the strange sense of lowness in the water. . . . . To conduct a flotilla of torpedo boats to the attack of ships is in itself an education; there are fifty wrinkles and dodges that will suggest themselves to a clever officer when practiced in making such attacks which he would never have dreamed of without."

Pages of similar extracts might be quoted, but these are sufficient to show that the opinions of those who are most familiar with the workings of the new arms point to the necessity of constant care and practice; and it is deemed therefore of the very first importance to practice on every possible occasion and under every possible condition of the weather. As an instance of the class of practice referred to we would cite the following: The German Government telegraphs to Wilhelmshavn: "A squadron in the North Sea is coming down to attack you, defend yourselves." The squadron came. It was a rainy, storming night. They anchored some distance from the shore, and the Admiral, feeling sure that torpedo boats would never venture out, turned in to get his needed rest, having given no orders of a special nature. That night the torpedo boats were in the middle of the fleet and could have wrought great destruction.

It may be remarked that we have made no suggestions as to the sending of torpedo-men as instructors to our ships. Our experience with seaman instructors does not warrant the serious contemplation of such a plan. It is said to work well in the English Navy, and instructors in the various drills are drawn from the better class of men who are specially rated for the purpose. The complex character of the crews of American ships precludes the advisability of making the trial even. There are plenty of officers to do the instruction. In closing this part of the discussion we can only repeat that the instruction now imparted at the Torpedo School is as complete as in the nature of things is possible. It has been often said of the colleges for civilians, and of the Naval Academy for officers, that they serve only to prepare one for further study, if great success is to be attained. So with the Torpedo School, it lays the groundwork and prepares us for further study in one branch of the complex science of modern warfare. After theories are learned let us have plenty of intelligent practice as the best instruction.

IV.

THE TACTICS TO BE EMPLOYED IN OFFENSIVE AND DEFENSIVE WARFARE.

OFFENSIVE WARFARE.

Before proceeding to the consideration of the torpedo and torpedo boats as engaged in warfare either offensive or defensive, we desire to free the discussion of some weights which bear too heavily upon the just consideration of the subject. So much stress is laid by many writers on the terrible effects of rapid fire and machine guns that no consideration of torpedo boats is ever had without finding this "lion in the path." Reference has already been made in a general way to this subject, but we shall now particularize by giving a few instances to the point. "Experiments carried out in England by firing at models of torpedo boats show the number of hits that may be made by an approaching ship. In these experiments the mean result of six runs showed that the mean number of hits made from a ship steaming at 6 knots, when firing at a stationary target, was 16 per minute from a Nordenfelt gun, and 6 per minute from the Hotchkiss revolver cannon. The guns had the advantage of continuing the firing up to 100 yards, and the observers who were stationed near the target remarked that all the shot that were fired *under* 300 yards struck the boat."*

This is the most favorable showing ever made for these guns, to my knowledge; but for the sake of argument let us suppose that a torpedo boat is approaching this vessel at a high speed, say 20 knots per hour. How long will she be in the dangerous zone? 30 seconds if we extend the zone to 1000 yards, and only 15 seconds if we approach a more reasonable distance. In 30 seconds she will have received, by the above showing, 8 shots from the Nordenfelt and 3 from the Hotchkiss. At 500 yards, that is, from 500 yards circle to alongside, 15 seconds, she would have received half that number. This is a supposititious case in which everything is conceded to the gun. Let us turn from this most favorable result for the gun to another view of the matter. One night while in the river Min a boat was discovered approaching the French fleet; what her character was is not stated, but the electric lights were brought to bear and the fire of the whole of the Hotchkiss guns from four ships was directed at the boat. In the end they had to send steam launches

* Commander Gallway, R. N.

to bring her alongside, and they then found that *she was not even hit.* Comment here is unnecessary, except to call attention to the fact that the French gunners are generally well trained. Now it has been asserted that the machine-gun fire directed from the tops of the ships drove the cannoneers from their guns in forts Ada and Pharos during the bombardment of Alexandria, but a critical examination after the battle showed but a meagre number of bullet-hit marks on the guns or carriages, the number being less than *ten.*

Many other cases could be cited pro and con, but we will content ourselves by the results of target practice on an extensive scale, made very recently at Newport, R. I., under the intelligent supervision of the fleet gunnery officer of the North Atlantic Squadron. The Hotchkiss and machine guns were fired from moderately unsteady platforms at stationary targets. The results were highly unsatisfactory; so much so that we refrain from giving exact figures. These guns were fired by men who were to a reasonable degree familiar with them, and under direction of officers who knew what they were about. There is no disposition to decry the usefulness of these guns, but we are seeking to strip them of the exaggerations which always accompany them, and we would endeavor to show that the torpedo boat *may* have some chance for life, before we attempt to touch the subject of tactics. The other bugbear which torpedo boats are to contend with is the electric light. We have shown in another place that the use of the electric light before the boats are discovered has objectionable features. Let us quote from an officer upon whom we have already drawn. "I myself saw last summer (1884) a fleet of six second-class boats get within 50 yards of the flagship of the Channel Fleet before being discovered, although *six electric lights were employed in searching around the fleet.*"

During the recent night attacks on the Atlanta in Newport harbor, by boats carrying the spar torpedo, it was very noticeable with what distinctness the *white* boats were shown up by the electric light. In a later attack made upon the Dolphin several boat officers had taken the precaution to cover the bows of their boats with tarpaulins, and the difference between them and the *all white* boats was very marked when in the rays of the light.

It is to be hoped that these exercises may not be used as an argument against the probable success of a night torpedo attack, for the conditions of those attacks could hardly exist in modern warfare. In the first place, the Atlanta, having shifted her anchorage, proceeded

to use her electric light long before the time of the attack. In the second place, there is no room for comparison between white ships' boats, which were with but few exceptions the old time noisy wooden launches and a lot of pulling boats, and the noiseless torpedo boat rushing through the water at a speed of at least 18 knots, armed with a torpedo good for a 400 yard range. In the subsequent discussion of this attack the opinion was freely expressed that six modern torpedo boats would have left nothing of the Atlanta. In considering this subject of the search light it must not be forgotten that a fog, even a slight one, will do much towards neutralizing the power, or effect rather, of the light. Smoke will have the same effect.

In all operations the torpedo boats may be regarded as the cavalry of the Navy, to be in advance, or on either wing of a fleet at sea, or dispersed inshore, and outside of a fleet at anchor; ready at all times to give timely notice of the approach of an enemy; to carry despatches to a distant part of the fleet; to surround and destroy or capture a crippled foe and to pursue a fleeing one; to cut off supply ships and detached vessels; and besides this they may be sent on distant expeditions, or called upon to meet a similar body in almost hand to hand conflict. In all considerations of torpedo boats in connection with the fleet we refer solely to the 1st class sea-going boat. Small fleets of these boats are now organized under some flags, and we need not be surprised if the battles of the galley period be reproduced, as to the numbers of boats engaged and the tactics adopted.

The success of a torpedo attack will depend largely upon the number of boats which can be brought to deliver it simultaneously. Eight has been stated as the greatest number that can be kept together at night. In approaching an enemy the boats will maintain slow speed (because it is known that they can be heard much farther when moving rapidly than when going slow) until discovered or they get near enough to discharge their torpedoes. When discovered they must dash ahead at full speed. The commander is supposed to hold his boats well in hand up to the moment of the charge, after which each boat must act for itself, returning, if possible, to a pre-arranged rendezvous. In the attack upon a single ship, if at anchor, several methods have been suggested which we will quote. "In December, 1885, Capt. Dubuzof discusses some plans of attack of a Capt. Azarof which differ from the Russian official torpedo manual. The manual adopts 18 boats in two lines as a squadron, and directs that each line should form three lines abreast, endeavor-

ing to get abeam of the ship to be attacked, and then all bear down together. (Fig. 1.)

Under the circumstances shown in Fig. 1, each line of boats will be in danger of being enfiladed by ship's fire.

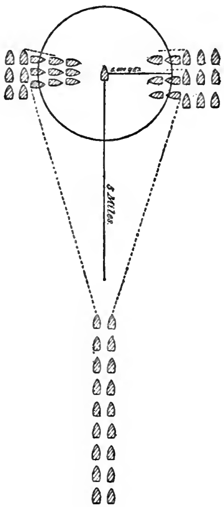

FIG. 1.

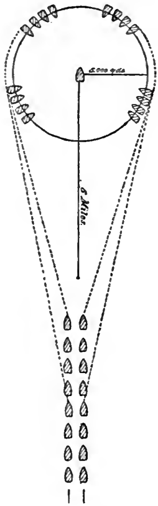

FIG. 2.

Captain Azarof's scheme consists in dividing the two divisions into four squadrons of four boats each. The boats are to try and form about the same distance from the ship, and attack from four quarters of the imaginary circle surrounding the ship (Fig. 2). It would be difficult to make the attack at the same time, as the distance between the squadrons of boats would be too great, and signalling cannot be done." A dark night, fog, or a dense smoke would be necessary for this evolution. Captain Harris, R. N., suggests the plan given below for an attack by day of ten torpedo boats on a ship.

"At a preconcerted signal these boats are to turn and rush at the ship. In ordinary weather they would be within easy torpedo range in six minutes, which is but a short time in which to destroy *ten* torpedo boats."

We would suggest that the attack be made from nearly ahead or

astern, if the vessel be at anchor, and that a number of boats be held in reserve to make *another* attack, if necessary, before the excitement caused by the first wore off and before quiet and order were restored.

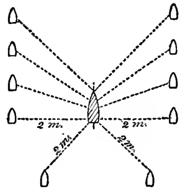

FIG. 3.

We would suggest somewhat the same tactics in attacking booms or a number of ironclads. If the ships be protected by a net or booms, the flotilla having approached to within safe distance, the commanding officer should detail a number of boats to make the attack, and he should wait until the mêlée was at its height, when he should approach with great speed and make an entirely distinct attack. The first attack will always develop the position of the search lights, and these he will assign to one or two boats in reserve whose whole duty will be to put the lights out of action. Let it be remembered that the new torpedo boats will all carry guns sufficiently heavy to effect that, and armed as they now are with many machine guns, they will be able to drive all people off decks and away from the rapid-fire guns; at least they can do as much with their machine guns as the big ship can with hers. Loss of life will doubtless follow, and the loss of some of the attacking boats, but no ship's company will maintain their composure under repeated attacks. It is not possible to believe that human beings can be kept at the machine guns after a series of explosions of torpedoes.

For a moment we have lost sight of the boom or net, but following the same line of tactics in the attack, we would send the boat whose machinery, boilers, and men were best protected, with orders to destroy the net, and it is on just such an occasion as this that we want a spar attached to our torpedo boat; a heavy charge of gun-cotton borne at the end of a spar would do this kind of work. One good torpedo exploded against the net will tear a hole sufficiently wide to admit the entrance of a second torpedo.

If torpedo attacks are to be attended with great success the risks

must not be too closely weighed, and much will depend on dash. While it may be true that as a general thing the torpedo boat will be regarded somewhat in the light of a skirmisher, it is also not at all improbable that they will be massed and take part, either in general engagements or as a flotilla opposed to a similar body of the enemy's boats. Torpedo boats have attained such a size—now carrying machine and rapid-fire guns, and in some cases a respectable sized breech-loading rifle—that they become in reality small men-of-war.

Whole pages could be written setting forth the various tactical manœuvres possible to any fleet of steam vessels, all very well as a parade and duly executed as per signal; but if two squadrons or flotillas of torpedo boats approach each other to do battle, the "charge through" will probably be the general rule, delivering machine gun and rapid gun fire in passing, and perhaps ramming if opportunity is afforded. The firing of torpedoes will take place perhaps when at about 300 or 400 yards distant, but in the mêlée which must inevitably follow it will be difficult to distinguish friend from foe. It will then be unwise to fire the torpedoes; the targets presented are small and easily missed, and as most of the boats are of light draft, the torpedo will pass under them and as likely as not bring up against a friend. Having charged through, there should be an immediate reforming for a renewal of the charge. The details of this formation should have been arranged long beforehand, as should all orders for the performance of certain manœuvres in certain contingencies. Signalling cannot be depended upon, and commanders of torpedo flotillas should, and perhaps will, have some agreement with the officers in command of the boats, that in the event of being attacked in certain formations each individual is to do the same thing under all circumstances. Take this matter of "charging through" an enemy's squadron, for example. Let us suppose that *A* has instructed his officers that always under such circumstances the survivors will, as soon as well clear of the enemy, come about, using, say, starboard helm, and reform bows toward the enemy; let it be supposed that *B* has made no such agreement, but depends upon his ability to signal or transmit orders, then we will have some such state of affairs as is represented in Fig. 4, where we find *A* at *A'* in good order, ready to charge again, while *B*'s squadron will be scattered and in disorder.

For a good formation for attack we perhaps cannot do much

better than study the old Venetian "half moon," used with so much success by them when their galleys decided many a hard fought battle. Care must, however, be taken with the wings.

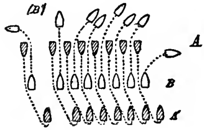

FIG. 4.

We shall now give a case of two flotillas approaching (Fig. 5). *A* is in "half moon" formation; *B* advancing in two lines abreast. *A* stands on, and his orders are that when the leading line of *B* shall be abeam of his (*A*'s) wing ships (Nos. 1, 2, 3, 13, 14 and 15), they shall wheel and attack *B* on the flanks, while the main body continues on to the direct attack.

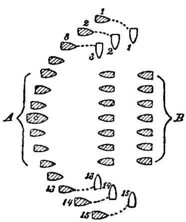

FIG. 5.

If a fleet of torpedo boats be ordered to attack an enemy's ironclads, a time should be chosen when information has reached us that their boats have been diverted to some distant duty. This attack should be made on a flank ship or one out of the line (Fig. 6). If it

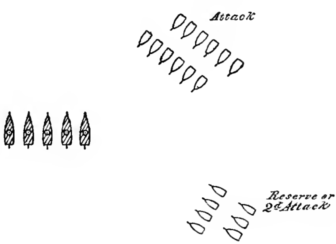

FIG. 6.

be known that our movements are under observation, a detachment should be sent in a direction opposite that to be taken later on by the real attacking party. This detachment will be ordered to appear as a reserve later on, and will form the "second attack."

It would of course be better if the flotilla could be divided into two squadrons to fall upon the two flanks simultaneously, having a few strong boats in reserve. We do not advocate, however, putting dependence on the "simultaneous attack." Great distances must be traversed, and many accidents may occur to prevent simultaneous action. All will depend upon the celerity with which the blow is delivered, and the sudden and unexpected repetition of the attack, if found necessary, delivered by fresh boats; hence our desire to hold some boats in reserve, out of sight if possible. In these suggestions we have not considered the small torpedo boats at all. They are reserved for defensive operations nearer home. We have under consideration our proposed 1st class torpedo boat.

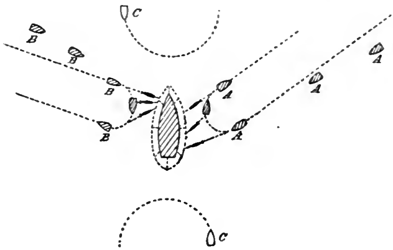

FIG. 7.

As to the attack on a single ship under way or at anchor, with her nets supposed to be rigged out in either case, we think that the attack must be carried out in some such manner as follows: A number of boats having been told off to that duty will assemble beyond range. Our *real* points of attack will be, let us say, the starboard quarter and the port bow, and two or three boats are detailed for each point of attack (Fig. 7). Those held in reserve are to make feints on the ship from ahead and astern, rushing at her from those points and wheeling off again. These will discharge their torpedoes if they find an opportunity, but it is their duty principally to distract and divide the attention. The main attack will keep the points of attack decided upon always in view, and it is ordered that they discharge, at the given point or near it, as many torpedoes as possible, so that the "nets" may be beyond doubt carried away.

Boats at *A* and *B* are to make successive attacks and wheel as shown in Fig. 7 so that they will not be in each other's way, and the boats at *C C* are to make feints as explained. If the attack be at night, *C C* should expose lights, or in some way insure being seen.

On all occasions where torpedo boats are engaged against each other, the one difficulty will be to distinguish our own boats even in daylight, but at night it will be still more difficult. It is suggested that the boats be painted some bright color which can be easily recognized at a glance, and which should be known to our people and not to the enemy. At night some other mode must be adopted to enable our boats to be distinguished at once.

It will be the duty of the torpedo boats, no doubt, to patrol in-shore of a squadron blockading a port, and to engage and capture any vessel emerging from the port, unless too powerful for them to engage, whereupon signals must be made to the squadron.

Defensive Warfare.

In defensive warfare the torpedo boat will be mainly used for sorties against the ships and boats of a squadron operating on the coast. A flotilla of torpedo boats being in a port, such portions as may be decided upon will be ordered for service on a certain night and they will proceed to the outside rendezvous. All plans must, as far as possible, be arranged in advance. For obvious reasons no signals can be made. Being on the offensive, they will adopt the tactics for attack. In this expedition the greater number of boats will be of the 2d class, accompanied by some 1st class boats as rallying points.

These boats will make their sudden and sharp attack on an enemy's blockaders or supply vessels, and should at once retire with all speed to such entrances or inlets as may have been decided upon beforehand, and from which they may return to their home rendezvous by inside passages. Attacks like this should be frequent, and perhaps need not be absolutely confined to nights that are dark and foggy. The peculiar coast line of the United States is favorable for secret and rapid concentration by the use of inside bays, lagoons, sounds, and canals. Boats supposed to be blockaded in New York may suddenly appear in numbers in Chesapeake Bay or Albemarle Sound without any blame resting on the blockaders, and it is this kind of warfare that will call the 2d class boats into play and will demonstrate their great usefulness.

Sudden attacks should be made on any and all vessels of an enemy

approaching our coast or attempting to anchor anywhere near it. It will always be urged that the torpedo boats will be destroyed; so some of them will: lots of them may be, perhaps; but the loss of a few inexpensive and easily replaced torpedo boats will be of little moment if we destroy only one of the battle ships of an enemy; and even if we fail to destroy *one* ship, still the frequent repetitions of these attacks will impose constant watchfulness on the crews of the enemy's ships, and finally so harass them that they cannot remain on the coast. An active officer having at his command a number of swift torpedo boats and a complete knowledge of the coast, and having in his employ sources of obtaining reliable information, would make it very difficult for an enemy to provision or coal ship anywhere near the coast.

Let us suppose an attempted blockade of New York. Of what avail would be the usual disposition of the forces of an enemy? of what use the usual electric light rays thrown on the egress channel, or the ceaseless vigilance of an inshore squadron of torpedo boats? There are many channels of egress open for light draft vessels. What will prevent us from putting a lot of 2d class torpedo boats on platform cars and transporting them to New London, or, better still, to the inlets and bays of Long Island, which being in connection with the sea will permit egress there.

A rendezvous having been arranged at the head of some bay, on a certain day or night, our flotilla sallies out and attacks the blockaders in rear and on the flanks. It is quite within the possibilities that a number of 1st class torpedo boats having made rendezvous at Charleston, S. C., or Hampton Roads, will have been ordered to make an attack some time during this very night from the other side. There seems to be no room for doubt as to the expediency of maintaining a large number of the 2d class boats in every port for the defense of the coast. These under the shelter of a few strong 1st class boats will keep the enemy on the alert, to say the least. The possession of a number of the larger boats will have a tendency to render convoys necessary, and would thereby divert a certain number of fighting ships from the active operations on the coast. It will be said that the merchant steamer will be armed, or that any ordinary cruiser may do convoy duty; but there will be required a very good ship to do battle with the torpedo boat as now proposed, with her great speed and protection and respectable armament.

But little reference has been made to the matters of harbor defense, mining and countermining, or spar torpedo tactics, as we do not understand that these subjects come within the limits of the paper.

We do not think that we shall have, perhaps we shall never need, the large fleets composed of heavy ironclads, torpedo catchers, torpedo boats of various classes, torpedo depot ships, coal supply ships, and numerous other ships. We may read seriously discussed plans of operations of fleets so constituted, numbering upwards of one hundred vessels, in any recent volume of the Proceedings of the Royal United Service Institution. Such an assemblage of vessels may become necessary for England in her possible wars in the future, but will hardly ever be necessary for us.

But a fleet of powerful vessels with the latest and best torpedo outfits, both auto-mobile and spar torpedoes, and high powered guns, will prove the best coast defense, supplemented by the fast sea-going torpedo boats. It should be only as a last resort that we should contemplate the closing of our harbors and the resort to submarine mines and booms as a means of defense. Having strong fleets on our Atlantic and Pacific coasts, as well as in the Gulf of Mexico, they would intercept and engage any hostile fleet that approached our shores. If beaten or repulsed we must have fortified harbors to fall back upon, and then in the defense of the immediate waters of the harbor the 2d class torpedo boat would play its part, while some of the 1st class boats might perhaps be detailed to create a grand diversion by being sent to attack the commerce of our enemy in the West Indies, for instance.

It is rather a difficult task to suppose a system of tactics applicable to vessels which we only know by reputation and with whose real qualities we can only become familiar after some years of experience.

New inventions are coming up every day, and it is impossible to foresee where the competition between the offensive and the defensive will finally land us. Not only is this so in the United States, but it applies to all the great naval powers as well. The possibilities of the dynamite gun and its shell; the possible solution of the long studied and oft tried problem of submarine navigation; the uses to which electricity may be put, and the problem of nullifying the search light,—all are examples showing how greatly the inventive powers of man are called into play at the present hour in perfecting engines of war. It behooves us to take the best, that which the experience of others has proved to be the best, and the object kept before us in this paper has been to outline what seems the best of the known and approved weapons. As to other and untried weapons, it may be as well to do as we have done—wait a little.

All writers on the modern implements unite in this one statement, be their opinions never so greatly at variance generally: "What is needed is the experience of a great war with the modern weapons." It is after that event that we shall see many theories dropped, and perhaps some of the old methods will be found to hold good.

DISCUSSION.

NEWPORT BRANCH.

JUNE 1, 1888.

Commander THOMAS NELSON, U. S. N., in the chair.

Lieutenant HOLMAN.—It is due to the essayist, in considering the paper that has been presented to us for discussion this evening, to bear in mind the fact that he undertook no easy task in grappling a subject which covers so wide a field, in the limited space allowed under the rules governing the contest for the prize of 1888. His feelings, when he found himself face to face with the topics allotted, must have been akin to those of the noted historian of whom it is related that, being seated at dinner next to a young lady who regarded it her duty to draw him out in agreeable discourse, the smiling demand was made, "My dear Mr. Blank, do tell me the history of the world!"

My first impulse is to congratulate the writer on having brought together, in such compact form, so many items of interest; my next, to regret that it was not in his power to expand certain ideas of which, under the circumstances, he could give no more than a hint. It would be manifestly unfair to criticise adversely any omissions, such as, for instance, some of the very important requirements of torpedoes and torpedo boats; or any lack of details in the consideration of organization, instruction and tactics; but there are some conclusions arrived at in the essay which I am not prepared to accept as quite correct, and I venture to allude to a few of them.

As to the place assigned the torpedo, compared with the gun and the ram—are we justified, as things now stand, in conceding it to be the most powerful of the three? Can we give other than theoretical reasons for such a preference? I must avow a strong personal predilection in favor of the torpedo, and hope that the essayist is right in stating that we must yield the first place to it; but, with all my bias in favor of the weapon, I shall want more proof before I consider the case established. The record of the gun is a long one and a strong one, and the limit of its destructive powers is not yet reached. Every day brings us news of some improvement made, some device by which its range, its accuracy, its ease of manipulation, or its rapidity of fire is increased, and the time seems not far away when the use of high explosives in projectiles, fired from ordnance of whatever caliber, will be quite practicable, and the gun will multiply its present power many-fold. It would hardly be wise to prepare

our naval estimates to-day on the assumption that the torpedo is a more powerful weapon than the gun. France approached that danger not long ago, but was warned from it by the earnest voices of her friends, who argued justly that, while the torpedo is worthy of a prominent place in preparations for war, and while it is a weapon of mighty possibilities, it has, nevertheless, not yet been submitted to such tests, to be had only in actual battle, as are necessary to prove its exact value. While awaiting these tests, let us by all means have plenty of torpedoes, and that at once; but let us, before we cease to place our main reliance on the gun, follow the advice given in nearly the last sentence of the essay—"wait a little."

It is with pleasure that I notice first class torpedo boats advocated as those essential for the service of the United States, with, however, somewhat larger dimensions recommended than will probably be needed to enable them to keep the sea and make attacks in all weathers. A minimum length of 150 feet, with other corresponding dimensions, would probably bring into our flotilla no boats too small for efficient service at all times. The luxury of protective decks and of relatively heavy plating for the conning towers in these craft cannot, I fear, be indulged in beyond a very limited extent. There is a loud call for greater solidity in the construction of torpedo boats, a response to which would necessitate giving to the frames and bulkheads and plates almost every pound of available spare weight without by any means converting the boats into miniature ironclads. I see no possibility of an extension of the great contest of gun *vs.* armor to secondary batteries and torpedo boats. The boats must not be handicapped, but must rely almost entirely for immunity from damage by hostile fire on quickness of approach to the attack and in recession from it; on such concealment as can be gained in darkness, fog and smoke; on the confusion attendant on surprise, when surprise can be effected; and on the extreme difficulty, certain to embarrass those attempting their repulse, attending the finding and keeping of their range.

I am inclined to believe that the suggested plan of having a torpedo depot ship whose duty it should be to visit the different stations in succession, would not meet the requirements of the torpedo service, for the reason that there very probably would be causes interfering to prevent much needed visits. A greater degree of independence would be secured by attaching to each division, to cruise and to operate with it, a torpedo division ship, such, for instance, as those recently built by Schichau, a description of which may be found in the *Marine Engineer*, June 1, 1887. These division ships carry a full outfit of stores and spare parts, and are fitted with workshops and with hospital accommodations. They are designed to guide the divisions to which they are attached, and carry a full outfit of torpedoes and of rapid firing guns, and would constitute, on the whole, a most powerful adjunct to the flotilla.

In the part of the essay devoted to the organization of the torpedo service, I deprecate two proposals: first, that which advocates the establishment of the Torpedo Corps virtually as a separate bureau; and second, that which recommends the dissociation of naval officers from the corps to the extent set forth.

The first of these propositions is faulty in this, that it is a direct advocacy of diffusion of authority, that fruitful source of weakness in the naval or military administration of any nation subjected to its baleful influence. Centralization should be our watchword. All things designed for the accomplishment of a common object should be solidly compacted, to the end that they may work together without the possibility of clashing due to conflicting policies. Citation of the growth and efficiency of the Signal Service, the Life Saving Service, and the Revenue Marine Service, or of any other services whose chief duties are of a distinct and separate character, is no argument in favor of an independent and separate management of the Torpedo Service, which must of necessity work in harmony with and as a part of the entirety of our naval force in aggressive as well as in defensive warfare. Why should we try to make ropes of sand?

The second proposition to which I have taken particular exception—that looking to the eventual exclusion of naval officers from the Torpedo Corps, except in a few leading positions—would have been passed by in silence as a harmless one (harmless because it can never by any possibility be adopted) were it not for the unfortunate statement that "it is not necessary to contemplate the diversion of a large number of officers from their legitimate duties in order to form this corps." What! Is it possible that the handling of the naval weapon ranked first in the list is a duty not legitimate for naval officers? Are we to believe that "in the event of war, the calling in of great numbers of officers now on detached service" would necessitate the entrusting of this detached service duty, in great part, to men whose knowledge of naval warfare, not being the sole aim of a lifetime of work, must be comparatively limited? Where would these officers rally, legitimately, when called from the torpedo? Around the gun?

I hope the essayist will modify the objectionable phrase, and that he will join me in regarding as legitimate for naval officers all work that naval officers can do better than other men. If such work becomes too great for the number allowed on our list by law, the remedy—an increase of the list—is easy for a nation suffering, like ours, with the pleasant complaint of a plethoric treasury.

Commander G. W. SUMNER.—*Mr. Chairman and Gentlemen:*—I have had much pleasure and instruction from the reading and consideration of the very able essay on torpedoes, from the pen of Lieutenant-Commander Reisinger, and while agreeing fully with many of his statements and conclusions, I yet find some instances in which I am unable to accept, without question, important points which he makes in his discussion of the various branches of his subject. In order not to take up too much time and space, however, in the present general discussion of his valuable paper, I will limit myself to a few brief remarks upon some statements occurring in the first three or four pages of the essay, as follows:

1. *Page* 484, *par.* 2. "In the group of submarine mines are all 'cases' or 'vessels' constructed to contain explosive agents, which are fixed in a certain position, being retained there either by dint of their own weight or moored

securely to the bottom." This definition of a submarine mine hardly seems to cover such a system as that proposed by Graydon, wherein the mines can be run in and out at will, and in any desired number and direction.

2. *Page* 485, *par.* 2. "Every one is expecting some new discovery which will revolutionize all accepted tactics and render war easy." I rather think that, on the contrary, we shall all the while find that new discoveries—whatever may be their effect upon "all accepted tactics"—will continually render war more complex and more difficult in all its phases; certainly such has been the effect of the introduction of great speed, of the ram, of the torpedo, of the high-power gun and of the rapid-fire gun.

3. *Page* 485, *par.* 2. "Again, the more recent machine guns used in the Soudan by the English gave great cause of complaint." It was the Boxer cartridge, I think, or defective ammunition, which gave cause for complaint in the Soudan engagements, and not any failures or defects of the guns themselves.

4. *Page* 485, *par.* 3. "It is generally conceded that the torpedo—automobile, self-directing and self-firing—will be a most prominent factor in all future wars." I am scarcely prepared to admit this, so broadly stated; it seems to me that, looking to the actual practical accomplishments of the automobile torpedo up to date, there is some ground for regarding its actual efficiency with a considerable degree of suspicion, and the danger to be apprehended from it with a slight degree of composure. Then, again, I am not unwilling to concede that there *may* be an important future, bearing upon the torpedo problem, in the idea of projecting high explosives in large masses through the air, with great force, high velocity and extreme accuracy. To my mind *this* idea requires the most careful consideration, and I should not be surprised should it eventually lead to some productions and results more to be dreaded by vessels of war than any automobile or other torpedo yet produced or likely to be produced. The moral influence of the torpedo is undoubtedly considerable, but I am inclined to think that the moral influence of the high-explosive gun is likely to be much greater.

5. *Page* 486, *par.* 2. "The torpedo has caused a movement which foreshadows the abandonment of the ironclad." The days of the ironclad do in fact seem to be numbered, but I am inclined to attribute this circumstance more to the great development of the power of the gun, and to the ram, than to the danger to be apprehended from the use of the torpedo.

6. *Page* 486, *par* 2. "There is no consideration as to the building of ships of war, or the fighting thereof, into which the possibilities of the destructive effects of the torpedo do not enter and become the *greatest factor*." This, I think, is rather an erroneous idea, and at variance with all practice up to the present time. We should not sacrifice speed, handiness, the ram, nor protection from projectiles, to any scheme for mere protection against torpedoes. And I do not agree with Captain Colomb, R. N. (see par. 4), when he says, "I think the effect of the torpedo is to push the ram back almost if not entirely, for I cannot conceive anybody attacking with the ram if he can attack with the torpedo instead." I should say, rather, never neglect an opportunity to ram—a sure thing—for the very uncertain chance of striking with a torpedo. If

you have reason to believe during the charge that you are not going to strike a fair and effective blow with the ram, then let drive your torpedo.

7. *Page* 486, *par.* 4. "As ships are now built, their destruction by artillery fire will be a most difficult operation." Their *destruction*, yes—but their *disablement* by projectiles carrying very large charges of high explosive, such as melinite, etc., I do not look upon as being nearly such a remote contingency; indeed, I regard this as being the contingency most likely to happen in the majority of cases, in daylight actions and engagements; certainly it will be the first method tried in nine cases out of ten.

8. *Page* 487, *par.* 1. "The torpedo will keep the ram at a respectful distance and defy the gun." I am quite willing to concede that the torpedo will defy the gun, indeed it *must* do so ever to be effective, but that it will keep the ram at a respectful distance I do not concede for a moment. No cool commander who sees an undoubted opportunity to give the *coup de grace* with the ram, will ever stop for an instant, to speculate as to the possibilities of being torpedoed ere he reach his mark. The possibilities, as matters now stand, are far too great in his own favor.

9. *Page* 487, *par.* 2. "To sum up this comparison between the gun, the ram, and the torpedo, we think the *first* place belongs to the last named weapon." I, on the contrary, would rate them in this order: Gun, ram, torpedo—believing that in most engagements the bulk of the work will fall to the gun; the greatest certainty of effect, when used, to the ram; and to the torpedo will remain to take advantage of those special chances and contingencies which are liable to occur in any engagement in open waters. Undoubtedly there yet remains a great amount of undeveloped force in the gun, in all calibers; and every addition to speed and handiness of the vessel tends to enhance the value of the ram.

10. *Page* 487, *par.* 2. "No vessel of the new Navy should be unprovided with automobile torpedoes and the means of firing them in any direction." I fully concur in this statement and trust that our service will soon be provided with a pattern of this weapon much superior to any now in use abroad, and withal one which is much more simple in its mechanism and manipulation. The devising and manufacture of such a machine does not seem to be at all an impossibility, or even a very great difficulty, judging from the many promising competitors which are even now in the field.

Lieutenant HAMILTON HUTCHINS.—There is one point in the essay that strikes me as being rather obscure. The essayist speaks of defending a ship against submarine boats, and proposes for the defense the use of the electric light under water. The essayist does not state to what extent this defense is to be carried out. If the lights are comparatively close to the ship, then there is no time for pointing the guns; if these are at a distance from the ship, the farther away they are the greater the circle of illumination must be. This, of course, can be done, but it renders the defense much more complicated. If any one can enlighten me on this point as to what extent the defense in this manner is to be carried out, I should be very glad.

Commander EDWIN WHITE.—*Mr. Chairman and Gentlemen*:—I wish to call attention to two points in the essay:

1st. The views expressed by the essayist relative to placing an officer of high rank, subordinate only to the Secretary of the Navy, in charge of all matters relating to torpedoes, I consider a species of naval heresy. The effect of this would be to establish another bureau in the Navy Department. The sentiment of the Navy is that for some years there has been too much diffusion of authority. Everything in connection with torpedoes should be under the cognizance of the Ordnance Bureau. It would be quite sufficient for the Secretary of the Navy to designate and detail such officers for torpedo work as circumstances may require. Those officers should not constitute a Torpedo Corps, but should go to sea in their regular turn.

2d. The idea of introducing into the service a new set of officers of a lower grade, termed 1st, 2d and 3d Lieutenants, would be unwise. Those officers would not be naval officers, nor would they belong to any branch of the military service; they would be young civilians with military titles. The introduction of such a class as accessories to an efficient torpedo service must imply that the number of officers in the Navy is insufficient. This, in face of the fact that thoroughly educated young naval officers are yearly being mustered out of the service, is an extraordinary assumption. The idea of having men not regularly enlisted, but employed along the coast as torpedo men, under the direction of hermaphrodite officers, should not be considered seriously. The young seamen of the Navy can be trained for work required in the manipulation of torpedoes, and they, under the direction of naval officers, should be the chief reliance.

In touching upon these points I beg that no one may infer that I condemn the essay as a whole. On the contrary, I consider it a thoughtful production, and I doubt not that its publication will be beneficial to the service.

THE CHAIRMAN.—*Gentlemen*:—We have listened with pleasure to your comprehensive and interesting remarks and criticisms on the Prize Essay of 1888, and, personally, I agree in the main with the opinions and ideas set forth. I think, however, that in judging of the preferences expressed and the methods presented by the essayist in treating his subject, we should do so leniently. It appears to me that his language in the early part of the essay implies not so much his absolute faith in the superiority of the Whitehead torpedo over any other weapon, as his belief that it is the best known and most efficient of its kind extant, and that its moral influence is greater than that of the ram or the gun. Hence his leaning to this arm and his recommendation and suggestions concerning it, on the general principle of taking the best we can get for the time being.

With reference to a question asked by Lieutenant Hutchins as to how the electric illumination of the water for the purpose of detecting approaching torpedoes is to be accomplished, I would say that the essayist can probably best answer the question himself. To me it appears impracticable, and even if possible, worthless as a means of torpedo defense, in so far at least as regards any electrical system dependent on a ship afloat.

With regard to the organization of a torpedo service on the plan of the essayist, I am inclined to protest. Passing by all minor details, I will simply say that in my opinion such an establishment would at once introduce a separate and independent factor in the solution of a war problem by the military commander present. The chief of the torpedo service being subject only to the orders of the Secretary of the Navy, could at any time seriously interfere with, if not actually defeat, the schemes of the responsible commander, by refusing, in the absence of specific orders from the Secretary, to co-operate with such commander in his plans. In short, any division of authority in military organization is reprehensible, and should be discouraged by all who have the welfare of the service at heart. The points in the essay having been generally covered by the arguments of Lieutenant Holman and other gentlemen present, I deem further remarks by me unnecessary, and, thanking on the part of the Institute the gentlemen who have spoken this evening, I now declare the discussion closed and the meeting adjourned.

The following remarks, received from some of those who were unable to attend the meetings, are, by direction of the Board of Control, here appended as a part of the discussion:

Rear-Admiral E. SIMPSON.—It is refreshing to have a subject like that of torpedoes, on which we have so much theorizing, handled in a thoroughly practical way. Lieutenant-Commander Reisinger has taken up the subject from the beginning and has carried it through, even to the tactics in the field which govern the use of the finished weapon, and in each phase in which it is presented, the needs of actual warfare are kept in view as the standard to which it must be referred. I may say in a word that I endorse nearly all he says and approve his conclusions and recommendations, but it may be more satisfactory to make a short review of the paper, and to indicate some points where I may differ in opinion, or on which I think some modification would be advisable.

The author will not expect me to yield, at this time in the action, to his demand for first place, in offensive weapons, for the torpedo. He is a practical seaman like myself, and he and I both know that, if we have determined to close with an enemy so as to deliver the torpedo attack ahead, we will not discharge our torpedo without shortening speed, and even backing the engine to deaden headway,—we don't propose to blow up our own ship. This operation will be sufficient to disclose our intention, and every gun of the enemy, large and small, will be concentrated on the point whence the torpedo is to be discharged. Such a searching fire will be apt to frustrate the effort. The practical difficulty of delivering the fire shows that the gun is the real key to the lock; if it is properly used, the lock cannot be opened. If, however, the attack is not frustrated, there is no limit to the consequences. There is no doubt of the superior destructive effect of the torpedo if successfully applied; but, ship against ship, the gun ought to control and frustrate the torpedo attack. In the darkness of night, however, and where torpedo boats attack in numbers, the

chance is better; but in a conflict between two ships, much is yet needed in the method of discharging the torpedo before it can be raised to the same standard as the gun. Until this is perfected, there is very serious danger that the torpedo may be exploded in the hands of those engaged in manipulating it.

As to the character of the torpedo required, I find the requisite qualities as stated by the author to be quite exhaustive, and some of the most important of them are not possessed even by the Whitehead, which he correctly states is the best that has yet been accepted and adopted by armed nations. The two qualities required to which I refer, and in which the Whitehead is deficient, are "certainty of starting on course" and "directing power." Mr. Gabriel Charmes, in his rather severe criticisms on the practice in the French Navy, in which he asserts that little or no practical exercises are had with the torpedo (Whitehead) which has been adopted, alludes to the nervousness induced among the operators by the uncertainty that the torpedo will start on its course,—I cannot quote chapter and verse, but the allusion points to the necessity of having this quality well assured. Those familiar with the Howell torpedo know that this is assured beyond peradventure in it, as the speeding up of the fly-wheel starts the engine at its highest velocity before it is launched. The superiority of the Howell torpedo is shown in this as well as in the other quality demanded, viz. "directing power," in which the Whitehead is wholly deficient, it being as impossible for the Howell torpedo to depart from the vertical plane of direction in water as it is for a rifle bullet to depart from it in air. However valuable it may have been some years ago for us to possess the Whitehead torpedo, the lapse of time has made it less necessary, for the new torpedo (the Howell), which is now going through its last experiments in exploitation, will soon assert itself as the successful rival, and will take the place of the less perfect weapon which has long held the field alone.

I am glad that Lieutenant-Commander Reisinger says a good word for the spar torpedo, and for a good strong ship's boat to carry it,—boats to be considered as entirely apart from torpedo boats for coast and harbor defense, boats for ship use, strong built for knock-about work as well as for torpedo night work. We are altogether too slow in our development of a ship's launch for both these purposes. In going from our old monstrosities, with their ponderous weight of hull and engines, the latter sounding to give notice of approach as if a train of cars was arriving, we content ourselves by rushing to the extreme of a Thornycroft, a Yarrow, or Herreschoff floating feather, with nothing in the world but speed to recommend it, and which almost tumbles to pieces in hoisting to the davits. It is very possible to construct good strong launches of moderate weight, with light boilers and noiseless engines, having fair speed, enough for all practical work with torpedo or otherwise, and these should be supplied to all ships. This is one of the practical wants of not only the present day, but of that future day of perfections realized which we look forward to; and Lieutenant-Commander Reisinger's words are spoken at a good time, and will bear referring to until the needs of the present, at least, are supplied. I like his remarks about electric search lights on board ship. I have very serious doubts as to their use being altogether advantageous.

The two classes of torpedo boats proposed seem to cover the ground, those of the second class being for the defense of coast and harbors, and capable of transportation. This last point is specially worthy of note when we remember that the British Navy List shows a class of gunboats fitted to traverse the Canadian canals, which have been deepened to allow their passage from the sea to the lakes. A word of caution is not amiss, in this connection, to those who have to do with the construction of railway bridges on the roads to be traversed while transporting boats and guns. A load of 100 tons and upwards in a limited length is one that has not been allowed for in calculations of strength for bridges, and this is a war element that needs to be looked to.

The first class torpedo boat will have to be a vessel of some size, capable of accompanying the fleet and of keeping the sea for some days; and I am inclined to conclude, from late experiences at sea with small torpedo boats, that the idea of utilizing them in this way must be abandoned and that battle ships may be relieved from this portion of their present load. The battle ship, however, and even the unarmored cruiser, may utilize the torpedo as a part of their own batteries; for, now that I regard the adoption of the Howell torpedo as a certainty, I look forward to the introduction of some method of launching it, such as a submarine gun, thus making it available in all ships. I would discard altogether the fire ahead with torpedoes, for, having the directive power of the Howell torpedo, it could be launched from the broadside with accuracy while passing an enemy at full speed, and the danger of running over your own torpedo would be avoided.

The practical suggestions for the organization of a torpedo service for the coast and harbors is a very useful piece of work done. We have theorized for many years on torpedo defense, but no plan for organizing a service has been taken up. The only idea that I have upon the subject that seems practical in our state of unpreparedness, is to fit out our harbor tugs with spar torpedoes, and I imagine this has suggested itself to many other minds as being the only method in which we could use what we possess; I know of no matured plan that has been submitted before the suggestion of Lieutenant-Commander Reisinger. In proceeding to the adoption of any plan it is very desirable to have a draft prepared as a basis; it stops desultory talk, and the subsequent discussion has an object, either to approve, dispute, or supplement what has been suggested. In this case, the suggestions in this paper may very well be taken as a draft of a report submitted for consideration and improvement. It is a problem of some difficulty to solve, and there is no doubt that it should be settled as soon as possible, as an interval must elapse from its origin to the time when it will be in working order. This is apparent from the fact that there are two periods to be provided for, the one introductory, the other the accomplishment. During the introductory period, Lieutenant-Commander Reisinger, after placing the torpedo corps under a chief independent of all bureaus, provides the force from officers of the Navy and from the training station. Its establishment as a permanent corps is a condition precedent to inducing boys or young men who have passed creditably through the training station course, to enlist for this service. The officers will not

be removed from their regular duties in the Navy, but the enlisted men are not to be subject to duty on board ship. All torpedo work on board ship will be carried on as now, under the instruction of regular officers, graduates of the torpedo school; and any enlisted men of the Navy who during a cruise may show aptitude for the torpedo service may be induced to re-enlist for this service, to which advantages of pay and position will be granted; grades for promotion will be established, and these may reach to a commission in the corps which will entitle the bearer to the command of a boat. The main supervision will always be held by the Secretary of the Navy, through the Chief of the Torpedo Bureau, and a certain number of line officers of the Navy will be in charge of the boats of the districts into which the whole coast will be divided. The corps will be regarded as is the Coast Guard in England, or the Life Saving Service and Light-house Service on our own coast; young men accustomed to the water will be attracted to the service, and good recruits may be found native to the stations. The pay must be good, for the requirements as to personal character and habits must be very severe, as is proper in all cases where explosives are to be handled. It seems to me that while much effort is being made in other directions for what is termed a Naval Reserve, we have in Lieutenant-Commander Reisinger's proposition an organization that is in itself the first and most efficient of all navy reserves; it calls for no men from the Navy, and demands the services of a few only of the regular officers of the line.

I long to see a good Naval Reserve established after we have succeeded in building up the Navy proper, but I think the construction of our new Navy is as much as we can attend to in that line at present. The maturing of some plan for providing for a torpedo defense of the coasts and harbors is, however, a necessity that has the first call, and if action can be infused into the councils that have this matter in hand, I commend the prize essay of this year as a document that may well be considered and studied for practical suggestions.

If we can find excuses for possessing no Navy to speak of, I suppose we may be excusable for not having provided for torpedo defense of the coast, inasmuch as we have no torpedo. We have neglected the era of the Whitehead, but the Howell is appearing now at the time when attention is being called to this detail of defense, and with it in our possession we can construct our boats to suit its requirements. The organization of the Torpedo Corps should go on with the introduction of the weapon; even with both provided, there will be much time required for practice to bring the practical results to a good standard of efficiency.

I make no attempt to follow Lieutenant-Commander Reisinger into the subject of the Tactics of the Torpedo. This is a wide field and must come up naturally in considering the entire subject, as the tactics is the application of the weapon for purposes of war. I rest with an endorsement of the paper, and with the hope that interest may be taken in preparing for a practical adoption of this formidable weapon for defense.

WASHINGTON, D. C.

General HENRY L. ABBOTT.—This able paper is specially interesting to Army officers where it treats of combined operations to defend the coast

against a naval attack. How this duty shall be divided to effect the largest results at the least cost, how each arm of the service shall be equipped to supplement most perfectly the deficiencies of the other, and how the joint duty shall be performed with the least chance of friction, are, in my judgment, questions second in importance to no military problem now demanding attention from Congress. These questions have been discussed ever since the foundation of the Government, and sometimes in a partisan spirit; but to-day broader views seem to prevail, and Lieutenant-Commander Reisinger has given them expression very happily.

Forts and submarine mines are quite sufficient to close important approaches, but, like the forts of an intrenched camp, they are unable to threaten the enemy with offensive returns. They must be supplemented by movable bodies in reserve, ready to sally out from cover so soon as a favorable opportunity occurs. A port defended only by forts and submarine mines may be easily blockaded; defended only by a fleet, it may be occupied by a superior naval force, whose chief object in making the attack, perhaps, has been to destroy the ships of war before they can concentrate with another squadron. Both land and naval elements are, therefore, indispensable to a perfect defense. What shall be the duty of each?

In most of our chief ports the topography permits the construction of so strong a barrier as to defy attack from the water, and the only question as to how nearly this standard shall be approached is one of cost. Heavy guns can be mounted so cheaply and so permanently that we do not take much interest in armored coast defense vessels, which at the best can only reinforce the land works where they are strong, and this at enormous outlay. What progress has been made of late in the much needed Sea Cavalry, and how far it can be trusted to perform duty beyond the power of anything which can be constructed on shore, are live questions in our projects of to-day. For this information we look to naval officers, and I may be permitted to say, with the diffidence proper to a non-expert, that the views as to types and character presented by Lieutenant-Commander Reisinger seem to me to be admirably well considered.

With two slight modifications I heartily endorse his general conclusions as to coast defense, including the organization of a Naval Torpedo Corps. Since any proper system of submarine mines permits the safe passage of our own vessels, I think that our ports should be closed against the enemy before rather than after a defeat has occurred upon the first or outer line; for to be effective, the mines should be planted with due deliberation. Again, when the enemy has closed in upon our lines, it is necessary that ordinary picket duty should be performed in a manner to meet every need of the officer commanding the barrier. To form an independent land organization afloat, as was done upon the Mississippi and on the James river during the late war, would, I think, be a mistake. It would be far better to arrange a close and cordial co-operation, and how this can best be done will demand the most careful study.

As a matter of historical accuracy it may be stated that the boat which sunk the Housatonic, although designed as a submarine craft, was used on that occasion as a surface boat carrying a spar torpedo. General Beauregard makes

this statement in Vol. V., Southern Historical Society Papers, adding that he refused permission to Lieutenant Dixon to make the attempt under water on account of her previous tragic history. Another common error (not appearing in this paper) is that the boat was subsequently found lying near the Housatonic. The late General Gillmore, under whose direction the wreck of the Housatonic was removed, informed me that, although carefully sought, its remains were never discovered.

Perhaps the conclusion that the electric light forms "a most excellent target" admits of question. It is claimed that, dazzling the eyes of the gunner, the source appears to be a moving object, and that its changes, eclipses, and flashes confuse him. Recently, in Russia, two light batteries practiced at an elevated light and reflector at a range of 1485 yards without any effect. Shells exploding beyond or short could not be distinguished from each other—all seemed to take effect near the light.

New York, N. Y.

Lieutenant Seaton Schroeder.—There are several points in this essay in which I find it impossible to agree with the author.

In giving the torpedo the first place among naval weapons, he takes a stand which is more novel now than it was a few years ago. The fact, as stated, that its greatest power lies in its moral influence is, I think, undoubtedly true, and does not well comport with the consideration of it as the most potent factor in naval warfare.

In the argument made in support of his position the essayist also falls into the error of comparing proving-ground trials of the torpedo with the records of the gun in action, 75 per cent of hits being claimed for the former (with a target 200 feet long, and it and the carriage at rest) and 25 per cent for the latter at sea and with 1000 yards range. Put the gun on the proving ground and the percentage of hits will be 100, and with a mark not the size of a ship but the size of an air-port. On the other hand, I think the hope of securing 30 per cent of hits with the torpedo in action is hardly borne out by past experience, nor is it very generally entertained.

In selecting the type of torpedo most suitable to the exigencies of naval combats, no one will probably dissent from the proposition to adopt an automobile fish torpedo, and the selection of the Whitehead is perhaps not very far from right; but while it is true that it is the only one of its family that has ever seen actual service, it should be borne in mind that on only one occasion has it ever proved successful. Proving-ground trials have a certain value for torpedoes as well as for guns, and in view of the fact that the Howell torpedo has a more accurate flight (in consequence of its inherent directive force), is handled with greater safety under fire, carries a heavier charge (on the same displacement) and is less liable to derangement, I think the lecturer would have been on safer ground if he had simply adopted a fish torpedo, instead of particularizing in favor of the Whitehead.

In the classification of torpedo boats and the selection of a type and size, the essayist somewhat contradicts himself; he drops from consideration the

torpedo-boat hunters of foreign navies as being swift men-of-war with many discharge tubes, and as not coming under the same head as the classes under discussion, and yet he adopts a vessel much larger than those built for duty as torpedo catchers, and armed and equipped in a way to fit her very much less well for a torpedo boat than for a swift man-of-war. The boat he proposes is 200 feet long, with 22 feet beam and a draft of 14; this should give a displacement of about 800 tons, which with the armament of four 6-inch rapid-firing guns, four revolving cannon and four Gatlings, makes quite a powerful gun vessel, while the possession of only four tubes, two on each side, would make her under-water offensive power much less than one ought to expect from a first class torpedo boat of such a size. Her draft of 14 feet also leaves her vulnerable to the torpedoes of the vessel attacked, thus increasing the enemy's means of defense. The old and charming idea of likening the attack of a torpedo boat to that of a microbe attacking an elephant has been proved illusory, and the move now is undoubtedly in the direction of larger and more powerful craft; but the vessel proposed in the essay has more gun and less torpedo power than many larger vessels that have won admiration among students and experimenters of naval tactics. A speed of 18 knots as proposed would also become a smart gun vessel, but would be rather inadequate in a vessel whose class name indicates that she is intended to wield first and foremost the weapon of the feeble. This criticism may sound carping and as an attack simply on the value of the word "torpedo boat," and that by merely changing that to "gunboat" it would be all right and the vessel would at once become a desirable one. She would certainly be a desirable vessel (though I would suggest putting 5-inch in place of 6-inch rapid-firing guns in a ship of that size), but the tactics discussed and suggested are applicable to craft belonging to the former type and not to the latter. In the plans of attack spoken of as emanating from Captain Dubazoff and Captain Azarof, the eighteen boats would aggregate nearly double the tonnage of the vessel attacked; and even in the more modest plan suggested, of twelve boats, their total displacement would probably equal that of the armored enemy. This would seem to smack more of a fleet engagement than a torpedo attack, especially as vessels carrying 6-inch guns and a secondary battery would have to have a considerable free-board to fight them at sea, where those vessels are supposed to be, and therefore they could not pretend to have the aid of invisibility as an element of success. And while torpedo boats in the usual acceptation of the term, that is from 100 up to 300 or even 400 tons, might approach in the manner suggested, deliver their subaqueous fire and wheel off, vessels of 800 tons would require to be at a greater distance apart, and if the captain of any one should find it impossible to resist the temptation of ramming the inert enemy, such action would sadly mar the concert of the movement, but would, if successful, bring the fight to a happy close by the skillful use of a weapon not apparently contemplated.

To put electric lights out of action by gun-fire from a floating and moving platform would be a difficult job, particularly as it is impossible to sight on such blinding points from anything like close quarters.

While on the subject of boats I may also add that the suggestion later on of painting them some bright color, known to our side and not to the other, would hardly be of avail, because the other side would know very well that none of their boats would be painted a bright color. At night it is proposed to use some other mode of identification which is not specified, and as the flotilla commander would scarcely fly in the face of experience so far as to have his fleet painted bright at night, I do not see how he intends to regulate the painting of these 800-ton boats.

In regard to the second class boats, there must be a misprint where the essayist is made to suggest a radius of only 60 miles for a 100-ton boat. Schichau's 90-tonners can run 3000 knots at 10 knots, and the productions of other builders do about the same. I think also the essayist is rather optimistic when contemplating their transport by rail; the handling of the weight of a 100-ton boat and the support of such a fabric on two pivots can be managed well enough, but it is safe to say that there is not a railway in the United States nor in Europe whose curves, tunnels, bridges, etc., would admit of carrying a structure about 140 feet long and 15 or 16 broad.

On examining the proposed organization of the torpedo service, the most striking feature is the placing in the hands of volunteers the weapon that has been given the first rank in naval warfare. And it is hardly possible to consider the plan of sending the personnel of that corps on board a commissioned man-of-war to do certain torpedo service *under their own officers*, that is to say, presumably independent of the officers and crew of the ship. Without going into further detail, it would seem poor policy to create a new lot of commissioned officers (3d lieutenants, etc.) whose naval education would be so limited, while at the same time a number of gallant and well informed young men are being sent back into civil life every year after graduation from the Naval Academy for the given reason that there are no vacancies for them.

There is only one more point that I wish to raise, and that is the proposition to put the torpedo service under an officer in the Department, with the Honorable Secretary as his only superior. Just now, when every one seems to concur in the desirability of consolidating and reducing the number of bureaus in the much split-up Navy Department, it sounds strange to hear it proposed to add one more to the number, and that one for a simple service between which and that of the present Ordnance Bureau it is practically impossible to discriminate as regards the nature of the work whether afloat or ashore. Shells carrying high explosives find a sphere both above and below water; torpedoes also are used in air and in water; and in assuming control over the materials and the handling of armor-piercing and torpedo-case shell, or submarine and aerial torpedoes, it is difficult to see where or why the line should be drawn. Torpedoes constitute a branch of ordnance just as properly as guns do, and the present bureau is not a gunnery but an ordnance bureau. The material is not only of the same nature for the one service as for the other, but is actually in some instances identical; the training, duty, and work of the personnel also are exactly the same. There is, therefore, not only no good reason why the two weapons should *not* be together, but every reason why they *should* be under the same control.

TORPEDO STATION, NEWPORT, R. I.

Lieutenant-Commander F. M. BARBER.—I have read Lieutenant-Commander Reisinger's paper with a great deal of interest, and I think he has shown commendable spirit in taking hold of so difficult a subject. His general treatment of the matter shows a wide range of reading, and his advocacy of the extensive adoption of the torpedo into our service is much to be commended, but I must confess to being disappointed on arriving at the end of the first chapter to find that he has succeeded in convincing himself that the torpedo was the *first* weapon in point of importance as compared with the gun and ram. I am a believer in the submarine torpedo and in the aerial torpedo, but to promulgate the idea in a prize essay that they have surpassed the high powered, long ranged gun is unfortunate in the extreme, and tends to belittle the value of many excellent ideas which are elsewhere expressed in the essay. Perhaps in our navy, where we have none of us seen any modern gun or torpedo work either, it is not surprising that too much study of a favorite subject, unbalanced by practical experience, should beget an undue admiration; but if we would carry the statements, as made by the essayist at the end of this chapter, to their logical conclusion, we would simply have a navy of merchant steamers and paper boats armed with torpedoes to defend our coasts, to fight our enemies, and to capture his commerce and his sea-coast cities. Probably the essayist does not mean to give up guns and rams and armor *immediately*, but he relegates the two first to an auxiliary position now, and the latter he wipes out entirely in the future. On the principle of the survival of the fittest, guns and rams must eventually follow the armor.

It is reasonable to suppose that amid the varied requirements of modern warfare, a sensible man might have occasion to prefer a torpedo to a gun to meet a particular condition that might arise, or he might prefer a pneumatic gun for throwing an aerial torpedo to meet some other condition, or he might prefer a ram for still another condition; but for an all-round weapon of war that would meet the greatest number of conditions that he is likely to encounter, the gun outranks any weapon that has yet been made. When man controls the lightning's stroke he will have a weapon that cannot be surpassed, but there is no weapon in existence to-day that comes so near the lightning in its velocity, range and striking power as the high power rifled gun. The essayist gives away his case when he speaks about the captain of the "well appointed" ship who pushes ahead at "great speed" in spite of artillery fire "until he gets within torpedo range." He tacitly admits that speed is a *necessity* in the ship that carries the torpedo, and so it is; but it is not so with the gun, and, in this particular case, supposing the gun ship had the greater speed, the torpedo ship would be utterly at her mercy. The gun has greater simplicity, it has greater range, greater velocity, and greater accuracy than the torpedo; the latter has only a greater destructive effect and a less cost in its favor. There are times when the value of these two features of the torpedo are paramount, but to take advantage of them you must have favorable weather, great speed, and nerves of iron, and must take awful risks.

Again, the essayist says that "the torpedo has caused a movement which foreshadows the abandonment of the ironclad." Where is the proof of this?

He states that "the energies of naval architects are strained to devise some plan to make the vessels unsinkable." This is true; but it is to make them unsinkable in *addition* to being invulnerable, and not *in place of it*, as one might infer. He states that "there is no consideration as to the building of ships of war, or the fighting thereof, into which the possibilities of the destructive effects of the torpedo do not enter and become the greatest factor." This is true also, but only relatively so, because all the other factors had been encountered with more or less success before the torpedo devil appeared. Ask almost any officer what is the most formidable and most useful naval fighting machine to-day. He will answer, a modern armor-clad with plenty of guns and torpedoes, plenty of water-tight compartments, good speed, and a ram bow—and why? Simply because this represents the best *combination* that human ingenuity has yet devised. She can do anything that is most likely to be required to be done, to a certain extent. She may not do anything to perfection, but she is a good all-round ship to be aboard of. A Polyphemus might ram her, a Vesuvius might sink her, and so might a torpedo boat; but is there anything that would stand so good a chance (taking everything into consideration) of meeting successfully the great variety of enemies that *all ships* are likely to encounter, whether they be the forces of humanity or of nature? In any ship built for a special purpose you sacrifice everything to the specialty, and very properly. In nothing but the armor-clad do you find a happy mean. The experiments now going on at Chalons show the turrets to be practically uninjured after a prolonged battering with shells containing 197 pounds of melinite. Suppose they *do* find some time in the future that dynamite and melinite and gun-cotton shells will shatter the heaviest armor; *all* shells are not thus charged, and an unarmored vessel would suffer infinitely more in any event. The abandonment of personal armor on the invention of gunpowder does not afford a parallel case. That kind of armor had grown so cumbersome that fighting on foot was impossible, and a dismounted horseman, as was shown at the battle of Pavia, was a mere helpless armadillo that could be stabbed to death through the joints of his armor. A modern armor-clad, however, can be just as fast and just as handy as the unarmored vessel of the same displacement. She may not carry so much coal, but she affords infinitely more protection to the people inside of her.

In trying to resist the torpedo, the Italians have come to treble bottom ships. What is the result? Simply that the French torpedoes are growing larger. Probably the next step will be to use cellulose or something else in the bottoms to stop the holes automatically. The torpedo will then grow larger still. Eventually it is certain to overcome any bottom or net either, but by this time it will be so unwieldy as to be almost unmanageable. It will be a parallel development to what we have already seen in guns and armor. When this time comes, will the Italians be willing to go back to a half-inch bottom, so that their enemy can return to his little torpedo? Certainly not.

A parity of reasoning with regard to guns also would bring us back to an unarmored ship with four or five-inch guns and a single bottom, and yet would anybody in this audience like to go to sea in one and meet the armor-clad of a nation that had not been quite so *advanced* in its ideas?

There is a disposition on the part of all nations, for *pecuniary* reasons, to try and grasp one horn of the dilemma while avoiding the other, by building unarmored ships and arming them with heavy guns and torpedoes, just as we are doing with the Atlanta, Boston, Chicago, Newark, Charleston, etc. This is a very taking idea, and seems to be peculiarly adapted to catch the economist, but it is fallacious, and the best evidence of it is that the thin protective deck, which was at first gently insinuated into the interior of the unarmored vessel at a small additional cost and sacrifice of room in order partly to protect the vitals, has grown thicker and thicker and thicker, until now we hear of 5 inches and more in the latest foreign designs. Where will this end? Certainly not in the *abandonment* of armor. As Lord Brassey says in his latest annual, that of 1887: "The advantages of armor as a defense against heavy guns, and still more against light guns, is admitted and its retention must be accepted as a necessity. The problem with which we have to deal is the effective application of armor to ships which shall combine a high degree of efficiency with reasonable dimensions."

WASHINGTON, D. C.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

RECOLLECTIONS OF THE MEXICAN WAR:

TAKEN FROM THE JOURNAL OF

LIEUTENANT STEPHEN C. ROWAN, U. S. NAVY,
Executive Officer of the U. S. S. Cyane, Pacific Squadron, 1845–1848.

The Cyane, under the command of Captain William Mervine, joined the Pacific Squadron at Mazatlan, Mexico, on December 24, 1845. We found in port four of our fleet: the Savannah, Commodore Sloat's flagship; the Portsmouth, Commander Montgomery; the Levant, Commander Page; and the Constitution, Captain Percival—the latter on her way home from the East Indies. There were also in the harbor four English men-of-war, the razee America, the frigate Talbot, and the brigs Frolic and Spry.

Mazatlan was not a fortified town and could be bombarded effectively by three vessels—one in the old harbor (to the northward), one in the new harbor (to the southward), and the third inside of the White Rock (to the westward).

The mails through Mexico were unreliable and were soon cut off altogether, leaving the squadron almost without news. Hearing, however, that Gen. Taylor was at Point Isabel, and anticipating an immediate collision with the Mexicans, preparations were made and the vessels were soon ready for the expected conflict.

While matters were in this uncertain state, Lieutenant Gillespie, of the Marine Corps, appeared on the scene. Some excitement was caused by his arrival, but the hopes for service thus awakened in the Cyane's officers vanished when their captain was ordered to have his vessel ready for sea the next day. About noon on the day appointed, Lieutenant Gillespie came on board, and having announced that her destination was the Sandwich Islands and offered to carry the mails of Her Majesty's fleet, the Cyane shortly afterwards got

under way. The officers were surprised that Lieutenant Gillespie did not leave the ship before she sailed, but soon learned that he was on his way to find Captain Fremont, having secret instructions for him from Washington.

We arrived at Honolulu in March, 1846, and after a week's stay made sail for Monterey, Upper California, where we anchored on the 18th of April. Captain Fremont had started for the east some time before the arrival of the Cyane, but Gillespie overtook him and they returned to Monterey together.

The Savannah got in from Mazatlan July 2d, and on the 5th the launch of the Portsmouth came in from San Francisco with despatches from Captain Montgomery. Commodore Sloat, after consulting with his officers, decided to hoist our flag on shore. Orders were given to have the boats of the squadron* alongside the flagship, armed and equipped, on the morning of the 7th, and Captain Mervine was detailed to command the expedition. At half-past nine that morning the boats left the Savannah for the shore, and at 11 A. M. the glorious Stars and Stripes were given to the breeze, greeted by the cheers of our people and a national salute from the ships, the proclamation having been previously read. The flag was also hoisted by the Portsmouth at Yerba Buena [San Francisco], Sonoma, and Sutter's fort, as soon as her launch returned [July 9, 1846]. A competent force was left at these places to protect the flag. Captain Mervine remained at Monterey in command of the land forces, and I was ordered to land with the crew of the Cyane to put up a fort. I built a strong block-house with pickets, and was thus employed when the Congress, Captain Robert F. Stockton, came in. Shortly afterwards Captain Fremont encamped near the town with a mounted force of about sixty men.

Commodore Sloat having decided, owing to ill-health, to turn over the command to Captain Stockton, now did so, and sailed for home in the Levant on the 27th July. Fremont's troop was now mustered into service by Commodore Stockton, Fremont being appointed Major, and Gillespie, Captain, while the junior captains, lieutenants, etc., were selected from among the men. The party, thus organized, embarked on the Cyane, and on the fourth day thereafter arrived in the harbor of San Diego. Landing with the marine guard and a few sailors I marched up to the town a few miles away, and, having read

* There were in the harbor of Monterey at this time the frigate Savannah, flagship, and the sloops Cyane, Levant, and Warren.—ED.

the proclamation, hoisted the flag without opposition. The marines were left to guard the flag, being relieved in the afternoon by Fremont with a portion of his command.

After the departure of the Levant, Commodore Stockton went to San Pedro in the Congress and landed three hundred and fifty men to co-operate with Fremont in an attack on Gen. José Castro, who was reported to be in the Pueblo de los Angeles, the capital of Upper California, at the head of several hundred Californians. Commander DuPont* was ordered to bring his ship up and join Commodore Stockton with seventy-five men (sailors as infantry) and the marine guard. All possible dispatch was made, but it took the ship six days to run a distance of ninety miles, owing to calms and light winds, and before we arrived Commodore Stockton had quiet possession of the capital, Castro having buried his cannon and fled to Mexico.

About the 20th of August, the Warren, Commander Hull, arrived at San Pedro from Mazatlan, bringing news of the declaration of war and the taking of Matamoras. A few days later the Warren and Cyane were ordered to Mazatlan to establish the blockade. The Cyane captured two small vessels with cargoes of assorted merchandise bound to San Blas from Mazatlan, and the Warren cut out the brig Malek Adhel without firing a shot. After scuttling one of our prizes and sending the other in to La Paz, we stood for Mazatlan, communicating with the Warren and learning that they had just seized a vessel bound from Guaymas to Mazatlan with a cargo of flour.

The Cyane left Mazatlan the same evening and stood for La Paz in hopes of capturing the Mexican schooner Julia. We anchored the next morning in the harbor of Pichilinque, whence I went with the launch and two cutters to La Paz, and finding the Julia at anchor there, captured her without any trouble. I then returned to the ship, leaving Lieutenant Selden in charge of the captured schooner with a prize crew. The next day, on the arrival of the Warren, the Julia sailed for San Francisco.

The Cyane then put to sea in search of two gunboats said to be concealed in some of the bays on the west shore of the Gulf of California. Anchoring on the third day off the Mission of Loreto, I went ashore, and upon inquiry found that the gunboats were either at Mulejé or Guaymas. We then weighed anchor and stood to the

* Now in command of the Cyane.—Ed.

northward for Mulejé, where we arrived on the second day and were informed by an American named Adams that the gunboats had sailed for Guaymas six days previously; so we weighed again and anchored in the harbor of Guaymas at sundown. Both gunboats were in the harbor, one of them dismantled and hauled up on the beach. The other was partly dismantled, and as we rounded the point we saw two or three hundred men tracking her along shore to where the other was beached. There was much excitement among the people on shore; the women and children had all fled to the back hills. There were some troops of the line drawn up on the shore, and others were busily engaged throwing up breastworks to protect their boats, and we anticipated a nice little fight in cutting them out or burning them. I went on shore with a flag of truce to demand the surrender of the gunboats, threatening otherwise to shell the town. After some delay a flag came off from the commandant stating that he could not give up the boats consistently with his honor as a soldier. Some foreigners came off in a shore boat requesting a little time to remove their property, and were granted one hour by Captain DuPont.

While I was seeing preparations made for the bombardment, the captain called out to me that they had fired the gunboats and directed me to give them a couple of shell. I did so, but they fell short, and we fired no more until the ship had been warped close in. There was nothing left for us then but an old dismantled brig which Capt. DuPont said we must bring out. We sent in the launch and cutter, Mr. Harrison in the launch and Mr. Higgins in the cutter, the captain having ordered me to remain on board in charge of the battery. I opened on the town, and the boats commenced warping out the brig under a galling fire from the enemy, both from small arms and a couple of pieces of artillery which they had brought up. A single broadside now silenced the enemy. I fired the shell gun myself, dropping the first shell so near their largest field-piece that the crew went scampering off. The brig was set on fire as she was towed off the point, and was then hauled on shore and entirely consumed.

After a few days' stay we weighed anchor and made sail for Mazatlan; we found there the Warren and the English brig Frolic. The same evening the Warren sailed for San Francisco. We remained at anchor blockading all the month of October, during which time we saw no foreign vessels. A few coasters and small boats with flour from Guaymas attempted to pass between Venado and the mainland,

but were usually driven on shore by our boats which would be sent to cut them off. The captain soon forbade our boat expeditions, however, as whenever we started, the enemy, amounting to six or seven hundred, would line the shores and heights and open a brisk cross fire of artillery and musketry, and he thought a man's life too dear a price to pay for a little flour, as the enemy could at any rate be bountifully supplied with the necessities of life from the surrounding country.

On November 1, 1846, Captain DuPont reluctantly raised the blockade, as, owing to the non-arrival of the store-ship Keyland, which left New York in May, we were reduced to very short rations. We therefore got under way and left for San Blas in hopes that we might find the Portsmouth there and obtain supplies from her. She was not there, however, and we returned to Mazatlan. The detention of the Portsmouth was explained when a French corvette came in from San Francisco with the news that our troops at Los Angeles had capitulated to the insurgents, marched out with the honors of war, and had then embarked on board the hide-ship Vandalia in the harbor of San Pedro. Commodore Stockton on this had left San Francisco with all his available force for Monterey and other leeward ports.

We sailed then for San José, where we hoped to obtain some fresh water and provisions. Reaching that place we sent a boat on shore, which was met by a white flag, and a Mr. Mott, an American, informed the officer of the boat that the people of Lower California were friendly and would supply us with provisions; that water was abundant and good, but hard to obtain on account of the surf. Anchoring, we filled our tanks, took on board ten days' rations of live stock, and then made sail for San Francisco.

After a long, rough passage we anchored in Saucelito Bay. We found the Savannah, Portsmouth, Warren, and Malek Adhel lying off Yerba Buena, the former making preparations for sea. The officers of the Savannah informed us that when Stockton received intelligence of Gillespie's situation at Los Angeles he dispatched Captain Mervine in their ship to his relief. When they reached San Pedro they found Gillespie and his men on board the Vandalia. By daylight the next morning, Mervine, with a force of two hundred and fifty or three hundred, including Gillespie's men who had so recently been driven out of the Pueblo, set out for Los Angeles and camped at Domingo's Ranch that night without opposition. During the night the enemy threw a few shot into the camp without inflicting any

damage, but the next morning, shortly after the march was resumed, they appeared and opened upon our men with round shot. They were about seventy strong, well armed and well mounted. The first shot missed, but the second cut down two men, and the order was given to charge. The enemy retired, taking their field-piece with them, but, as soon as our men became winded, they halted, unlimbered and fired again. This was kept up for several miles, each fire laying a few more poor fellows low. At last a council was called and it was determined to return. Several had already been killed and wounded, and there were no means of transportation at hand. Luckily, however, a cart was found at Domingo's Ranch, and in this way they carried the dead and wounded to the beach, reaching which they at once embarked.

The Congress arrived shortly after this and all the crews were landed, only to be re-embarked two or three days later. Stockton told me that his object in landing the forces was to move on Los Angeles with Fremont, but that Fremont, unable to procure horses for his troop, had returned to Monterey. A few days later the Savannah was ordered to San Francisco, and Stockton, in the Congress, proceeded to San Diego to establish a base of operations against Los Angeles, and anchored off the bar some time in November [1846]. Taking two or three pilots on board, Commodore Stockton attempted to enter the harbor, but the ship striking heavily several times on the bar, they were forced to return to the outer anchorage.

On the same day with the revolt at the Pueblo, the people at San Diego rose and forced some volunteers, under the command of a man named Merritt, to evacuate the town and seek shelter on the whale-ship Stonington, then at anchor in the port five miles from the town.

Captain Merritt took charge of this vessel in the name of the United States, taking on board with him some American residents and friendly Californians. With this small party he determined to retake the town, and landed early the next morning, taking with them two small guns that they found on board the ship. Captain Hamersly, of the Stonington, a very gallant fellow, joined the expedition with his crew armed with lances and blubber spears, as did Don Santiago Arguella, a native Californian, and Don Miguel Pedrorena, an old Spaniard, both gallant men and good friends to our cause from the day of our first occupation of San Diego. As the small party neared the town the Californians hauled down the Mexican flag, cut down the flagstaff and fled to the hill-tops.

When Merritt and his party were driven out of San Diego they sent a boat to San Pedro, hoping to find some of our cruisers there and obtain relief. The Savannah was there, and Captain Mervine, who had just returned from his unfortunate attempt on the Pueblo, dispatched Lieutenant George Miner with fifty men, in the whale-ship Magnolia. Reaching San Diego shortly after Merritt's party had retaken the town, Miner assumed command. The town was entirely defenseless, and Miner at once threw up an adobe bastion and mounted two small brass guns on it. During this operation there were daily skirmishes between the enemy and our men, and it was at the height of one of these that the Congress attempted to cross the bar. In spite of the rather perilous situation of the ship, Stockton at once landed one hundred men, including the marines, to rescue the shore party.

After buoying the bar and channel the Congress entered the port, and Stockton left the ship and took up his quarters at Don Juan Bandini's. The Stonington was sent to Enseñado for cattle, and in the meantime, by the good management of Bandini and other Californian friends present, supplies were obtained from neighboring ranches. Stockton found that San Diego was the only port in Upper California where he could organize a force to put down the insurgents. An additional force was landed from the ship, and the heights that commanded the town were taken possession of and fortified, using the oil casks of the Stonington to support the breastwork. Merritt's volunteers were embarked on board the Stonington —now regularly chartered for the Government—and were sent again to Lower California for horses and cattle. The party disembarked at Enseñado, and proceeding by land some distance down the coast, collected about five hundred head of cattle and two hundred horses and mules, all of which they succeeded in driving to San Diego. The Stonington also brought some beans, wheat, and a small quantity of flour. Before this there had been nothing at San Diego which could have been used for the sustenance of troops, as the natives in possession of the country had driven off every hoof they owned.

During the absence of the party in the Stonington great exertions had been made by Lieutenant Tilghman to organize and equip a company of artillery from the crew of the Congress. Some of the guns were mounted by the ship's mechanics, others had been captured at the Pueblo. Mule harness was made of raw hide, and country carts, of which fortunately there were enough with American wheels, were fitted up for baggage and ammunition wagons.

About December 5, Commodore Stockton received an express from General Kearney announcing his arrival at Warren's Pass with an escort of dragoons. Lieutenant Beale, U. S. N., and Captain Gillespie, U. S. M. C., went out with about thirty men to escort him in.

In his letter to General Kearney, Commodore Stockton congratulated him on his arrival in the country, and stated that a party of the enemy under Andres Pico were encamped in San Pasquale. It appears that on receiving this information from Gillespie, General Kearney deviated from the direct route to San Diego for the purpose of surprising this party, said to amount to seventy or a hundred mounted men. Encamping within a few miles of the enemy, Lieutenant Hammond, two dragoons, and an Indian were sent forward to reconnoitre. When they were within a short distance of the village the Indian was sent ahead. It is said that he entered the camp, dragged an Indian out and was getting information from him, when Hammond, fearing treachery, rode up with his two men. Pico heard the jingle of their swords and the tramp of their horses and immediately called his men to horse. The scouts retreated, and, as I understand, met General Kearney a short distance from the enemy's camp. He at once quickened his march so as to reach the enemy before they made off. When the advanced guard reached the foot of the hill that overlooks the village, the order was given to "trot." The order was mistaken for "charge!" and off they started with the usual cheer. When passing the Indian huts Captain Johnston was shot through the head and fell dead from his horse. As General Kearney rode up, the enemy, seeing the advance so far from the main body, closed on them and made a deadly onslaught. News reached Moore, commanding the main body, that the General was in danger, and he made an impetuous charge, driving the enemy before him. Unfortunately, the charge was too impetuous, and the enemy seeing them in disorder and so far from the artillery, closed again and began dealing death and destruction among the brave fellows. After some delay the howitzers were brought up, and our men rallying around them, the enemy fled at the first discharge. The mules that dragged one of the howitzers, however, took fright and dragged the gun into the enemy's lines, where it was captured. General Kearney camped on the field, but he had lost many of his bravest officers besides a number of the rank and file.

The next morning Gen. Kearney resumed his march for San Diego.

At Snook's Ranch, or Pañaseitos, the enemy, who had concealed themselves in the gulches, made a faint charge and then retired, taking possession of a rocky hill commanding the gulch and the bed of the river through which the soldiers had to pass to gain the main road leading up the opposite hill. When passing the rocks, about thirty of our men, led by Beale, of the Navy, Emory, of the Army, and Gillespie, of the Marine Corps, made a gallant charge and sent the Californians flying. Kearney finding himself in a good position on the hill-top, camped there for the night, much harassed by the enemy.

An express had been sent to Stockton, but as Kearney feared it had not reached San Diego, and as he was in a desperate strait, he allowed Lieutenant Beale to try and pass the enemy's lines. He had at first refused Beale's request owing to the dangerous nature of the enterprise, but when Kit Carson and an Indian volunteered also, he let them set off. These three, after many hardships, finally reached Stockton, and he acted immediately, sending two hundred sailors and marines under Lieutenants Gray and Zeilin to the rescue. This party had with them one cannon which, as there were no horses, was dragged by sailors. Lying concealed in the daytime and making forced marches by night, this party arrived at Kearney's camp in two nights and a day, to the great delight of the poor fellows who had been shut up on the knoll and reduced to eating mule meat. Early the next morning ambulances were prepared for the wounded, and the whole force marched into San Diego unmolested.

During General Kearney's convalescence from a wound received at San Pasquale, Stockton completed his organization of a sailor force for another attack on the Pueblo, and just at that moment the Cyane reached San Diego. The evening we anchored, DuPont received orders from Stockton to send him one hundred men, armed with muskets and under command of a lieutenant. Measures were taken immediately, and by nightfall of the next day, Dec. 26th, each officer and man had knapsack and haversack packed and arms in perfect condition. Commodore Stockton assigned the command of the naval forces (sailors and marines) to me, giving the general command to General Kearney, and reserving to himself the supreme control.

At daylight, Dec. 29, my men were landed; Lieutenant Higgins, Acting Master Stenson, and Midshipmen Allmand, Shepherd, and Philip accompanying me. Captain DuPont and Dr. Maxwell went with us as far as San Diego. We reached there about 8 A. M. and reported to the Commodore. I divided the men from the Cyane

into two companies, assigning the pikes to Stenson and the muskets to Higgins. At 10 A. M. the forces under the immediate command of Kearney, consisting of about five hundred seamen and marines under Lieutenant Rowan, a company of dragoons under Captain Turner, and a company of riflemen under Captain Gillespie, left San Diego. The cart-drivers, Indians, and shepherds were commanded by Lieutenant Miner, as quartermaster, assisted by Arguella and Pedrorena.

After an advance of a quarter of a mile we found what labor was in store for us. Almost every ox-team became stalled in the sandy bed of the dry river and had to be dragged across by the troops; on a dead level the half-starved oxen managed to drag the carts, but when we came to a hill or a sandy bottom the troops had to pull them along. These extra labors were of hourly occurrence, and when we reached the place where we were to camp for the night the men were almost exhausted.

Our first camp was at the Soledád, nine miles from San Diego. This is in a beautiful valley affording grass and water in abundance, except during the heated term, when the water dries up.

We took up our line of march at 9 A. M. on the next day (Dec. 30), and after a very fatiguing march over a hilly country, encamped in a place which afforded grass and water. On the 31st we advanced as far as Pañaseitos, or Snook's Ranch; close to this camp is the rocky hill on which General Kearney was surrounded by the enemy after the fight at San Pasquale.

On January 7, 1847, we reached a ranch called Coyotes, and as we approached the bank on which the house is built, we saw one of the enemy's lookouts near a deserted hut. Seeing us unlimber a field-piece, he put spurs to his horse and disappeared.

Breaking camp about 9 A. M. the next day, at about 1 P. M. we reached an Indian rancheria, where we saw several of the enemy, who retired as we came up. We now began to hope that the enemy would measure strength with us, and delight was pictured in the faces of all. About 2 P. M. General Kearney ordered both wings of the main body to move by the flank and allow the ox-carts, three or four abreast, to come up. In front of these were placed the pack animals. The wings of the advanced guard were thrown to the rear and those of the rear guard to the front, thus forming a hollow square for the wagons and cattle. There was a piece of artillery in front of the advanced guard, and one in front and one in rear of the two columns of the main body, which now formed the sides of the square.

We had a sharp skirmish as we approached the San Gabriel river, the enemy posting their artillery on a height and giving us a brisk fire of grape. Their fire was soon silenced, and after an ineffective charge on their part, we advanced and drove them off, gaining the bluffs on which they had been posted, but losing two men. About 10 A. M. on the next day the enemy opened upon us again with three pieces of artillery from different points. As fast as we drove them from one position they would take up another, and so we continued, moving them back as we advanced, for about four hours, when they made another ineffectual charge, passing down the lines like lightning. About 4 P. M. the enemy made their last charge, which was beaten off by the coolness and steadiness of our troops. The sailor force, I think, acted better than any other irregular body of the same experience and training. Several men were killed and wounded in these skirmishes; the dead were buried and the wounded carried on in the carts. We encamped that night [January 9] on the bank of the Pueblo river, and fortified ourselves against a cavalry charge by putting the baggage wagons fifteen yards in front of our lines and running ropes from one to the other. During the night we were much annoyed by the enemy firing into the camp and attempting to stampede some wild mares among us.

January 10, a flag of truce came from the enemy with an offer to surrender the capital on condition that life and property be spared. The Commodore acceded to these conditions, and we entered Los Angeles about 2 P. M. without further opposition. Two days later Colonel Fremont entered the capital at the head of his force, having with him three pieces of artillery commanded by naval officers.

Shortly after Fremont's arrival, General Kearney withdrew to San Diego with his dragoons. On the day that he left I received orders from Commodore Stockton to march my command to San Pedro, *en route* to San Diego, whither he was to go by land. Consequently we broke camp the next morning, spent that night at Domingo's Ranch, and by 1 P. M. the next day my whole force was on board the Stonington and we were on our way to San Diego. Two days of discomfort, owing to bad weather and lack of room, brought us to San Diego, where I reported to Commodore Stockton and rejoined my ship.

In the latter part of April it was reported that General Bustamente was on his way with fifteen hundred troops from Sonora to Upper California. The Congress put to sea and in three days landed a

party of observation under my command. The Commodore landed and remained with us for two days, when he returned on board. About the third day after we learned that the rumor about Bustamente was false, when the Commodore again landed and marched with us along shore to Enseñado, where we all re-embarked in the Congress and returned to San Diego.

At San Diego I was asked by the Commodore to take his dispatches to Biddle at Monterey. Accepting the duty, I left San Diego accompanied by Mr. Norris, the Commodore's secretary, and a *vaquero*. After a very fatiguing journey we arrived at Monterey, having made about six hundred and fifty miles in seven days. We underwent many hardships on the way, but the natives seemed kindly disposed and we paid for only one meal during the entire trip. The next day I reported to Commodore Biddle and was assigned to duty on the Warren until the arrival of the Cyane.

On May 25 the Cyane came in, having on board General Kearney, who announced his intention to start for home on June 1, *via* the Rocky Mountains. Accordingly he left us on that date with his suite, consisting of Colonel Cook, Captain Turner and others, escorted by a mounted party, among them Colonel Fremont and his exploring party.

The Congress, under Commodore Stockton's command, had arrived about May 27, the Commodore intending to return home overland. In the latter part of June he hauled down his flag and on July 1 began his long journey home.

During our stay in Monterey we sent our two companies ashore daily for battalion drill, in which all the small-arm men of the squadron took part, preparatory for the contemplated service on the Mexican coast.

July 28, the Independence, Commodore Shubrick, arrived, and about August 8 the Columbus sailed for home. August 28, the Preble arrived from Callao. October 16, the Cyane, which ship I had rejoined, stood out of the bay in company with the Independence. The Erie got under way at the same time, but failed to reach out of the harbor.

On October 29 we hove to off Cape San Lucas and, communicating with the shore, learned that Lower California was in a state of revolt. On the morning of the 30th we exchanged numbers with the Congress off San José. At 7 P. M. the Cyane anchored off Palmia. The Congress and Independence remained in the offing until Novem-

ber 1, when we all anchored off San José. Finding the landing good, we put Lieutenant Heywood on shore with twenty men. Here we filled our casks with good sweet water and received daily supplies of fresh vegetables.

Commodore Shubrick having been officially informed that a revolution was about to break out, ordered a party of thirty mounted seamen to be sent into the interior as far as Todos los Santos. The party left San José under the command of Lieutenant Lewis, accompanied by Lieutenant Halleck of the Army, and Surgeon Maxwell of the Cyane, from whom I received the following account of the expedition: "The expedition bivouacked on the road the first night about five miles from the town. At early dawn the march was resumed and continued throughout the day, halting only to feed men and horses, the latter sadly in need of such care. About midday the command was met by two persons, Californians from Todos los Santos, *en route* for San José with the purpose of having an interview with Commodore Shubrick to assure him that in general the citizens of Magdalena Bay, at the head of which is the town of Los Santos, were not hostile to the United States, and that a faction was at the bottom of the unfriendly movement. They advised the return of our small force to the ship, as there was quite a force of Mexicans and Yaca Indians near Los Santos, in sympathy with the disaffected part of the population (at the head of which were the Padre Gabriel and the Alcalde), and ready to attack as soon as they could do so with safety; and said that the character of the passes and roads, or paths, was such that we could be ambushed at many points. The *paisános* were evidently in earnest, as their after-conduct proved, and desired to avoid a conflict which they felt satisfied would result in disaster to them. Giving full credence to the honesty of their purpose, they were directed to seek the Commodore and make their report to him, and we, not disregarding their timely warning, continued our march and, hot and weary, bivouacked at nightfall, but in a situation very much resembling 'rats in a rat-trap,'—steep hills immediately above us, a mule path in front, and a wide *arroya* on our flank.

"Fortunately the night passed quietly, except the barking of coyotes, and at sunrise we resumed our march, passing the defiles and Thermopylae straits without molestation, and taking up our quarters at night in the hamlet of Piscodores, about nine miles from Los Santos. We were very kindly received here, and left the place in

the morning under the impression that everything would be friendly on reaching our destination.

"As we were entering the town of Los Santos we were met by a fine-looking gentleman of about middle age, dressed in snow white linen, on a mule equally white. The Padre Gabriel, who most cordially welcomed us, rode with us to the Presidio and lodged us in his chapel, which adjoined the church and had attached to it a large corral, as was common in the early days of the country. All for awhile was *couleur de rose*. The officials came forward, who but half an hour before had accepted our proclamation while the sand on the ink of their rebellious predecessors was yet wet, and the Padre, head and front of the outbreak, was radiant with smiles (Judas) and an unconcealed satisfaction at this state of affairs. The cloud, however, was gathering: a sumptuous repast was ordered and universal hilarity prevailed; the advantages to be derived to both nations were discussed and the most friendly feeling was established.

"In the meantime mischief was at work outside. Our horses, sorry things at best, had been sent to some distant meadow for food, and as evening approached it was deemed proper they should be brought to the corral. At this point the Padre first showed signs of dissent from us. The horses, he said, were tired and would be in fitter plight for our return in the morning if left all night in the meadow. We could not dispute what he advanced, and would probably have yielded but for the unexpected appearance of one of the men who had warned us of the existing feeling on the part of the recent authorities. Calling one of the party aside after dinner, he asked for a private place where he could talk with safety. After some difficulty this was found, and it was then learned that the Mexican forces and their Indian allies were about thirty miles from us, and that the Padre had despatched one of his sons to inform them of our number and position and enjoining their immediate attack upon us. It was then determined to bring in the horses and corral them in the church enclosure. This gave great uneasiness to the Padre, and when the church bell tolled eight and the tread of the sentry was heard on the flat roof overhead, the Padre, who was enjoying a fragrant Havana, inquired the meaning, and being told that the sentry would pass him out or in as he desired, sprang from the table, rushed into his sanctum, closed the door and was not seen until the next morning. The entire premises had been barricaded and sentries placed; and none too soon, we were convinced, for Monseigneur

Gabriel had dispatched another messenger to hasten the movements of the enemy.

"In the meantime our men had been tampered with. Rum had been smuggled to them, flints had been extracted from their muskets, and in the morning they were in rather a dilapidated condition, and, not much used to riding, could scarcely keep the saddle. The Padre seeing this, dispatched, we were told, another messenger for his allies, hoping that they could intercept us should we leave in such a plight.

"Having satisfactorily arranged affairs with the newly formed municipality and no enemy appearing, it was determined to retrace our 'march to the sea' as soon as the men of the command had somewhat recovered from the effects of the too liberal hospitality of Padre Gabriel and his sons. We therefore paid our bill and took up our line of straggling march; the old Judas, again on his white mule and in his snow white attire, accompanying us to the edge of the town, though he had previously promised to go as far as his ranch that we might have a taste of *his* delicious rum.

"Reaching Piscadores about sunset we determined to rest there for the night, though we found a wonderful change in its hospitality and could with difficulty get our wants supplied. After the watch had been set, and far on in the night, we were suddenly aroused by a deep-toned voice calling '*Americano! Americano!*' On bringing the intruder before the officer commanding, he stated that the Mexicans and Indians under General or Colonel Pineda were in hot pursuit of us, and begged we would leave at once so as to reach a pass where two could not pass abreast; that he had been shot at in his attempt to reach us, and that his brother had to make his escape also. Antonio was even beseeching in his earnestness and evidently believed all he said. A council of war was called and it was decided to stay where we were and make breastworks of saddles and blankets and what we could get, and if not molested, to move on in the morning. This decision was agony to Antonio, but there was no help for it, so he went off to a fishing village near by and took refuge on an American whaler in Magdalena Bay. This man afterwards made his way to La Paz, and it was he who later on procured horses for Lieutenant-Colonel Burton to enable him to send the expedition to San Antonio that rescued the officers of the Navy imprisoned there. We passed rather an uneasy night, but the bright, beautiful and fragrant morning of Lower California found us safe and rested, and after rewarding our unwilling hosts we returned without further incident to our respective ships."

It was hoped that the two successful expeditions under Lieutenant Selden and Passed Midshipman McLanahan, respectively, in which quite a number of prisoners, including Padre Gabriel, were taken, would have quieted all open opposition to our rule, if rule it could be called when the mild but firm administration of Captain DuPont almost persuaded the governed that they were the governors; but a few dissatisfied persons, at the head of whom was a captain in the Mexican service, residing in Lower California, thought proper to play the guerrilla by attacking those friendly to us and intercepting supplies necessary to the comfort of the garrison at San José. With the view of suppressing this chief, Captain DuPont offered a reward for his apprehension. As the Californians had no love for Mexicans, this reward would undoubtedly have produced the offender, perhaps accompanied by a catastrophe. This man's family, however, had on more than one occasion been kind and hospitable to our people as they passed and repassed the hamlet of Los Palos on the direct route to Santiago, San Antonio, and other more inland towns. This kindness was not forgotten. Therefore, to avoid trouble and distress to the family, it was resolved to try milder means to bring in the insurgent chief. Permission was obtained of Captain DuPont for an effort to this end. Accordingly, Surgeon Maxwell, with Mr. Gillespie, an American resident, as interpreter, and three or four Californians, left the Cuartel of San José in the evening, and gaining the table-land commanding Los Palos before nightfall, waited until dark to descend unobserved, if possible, to the hamlet and surprise the object of their search. The movement was quietly made, the horses left in a ravine in charge of an armed native, and by two paths the party carefully approached the house known to be the residence of the Mexican captain's family and where it was expected to find him—but who or what can escape the vigilance and acute sense of smell of a Mexican dog? He gave the alarm and the culprit fled by a path better known to him.

The game was not up yet, however, neither was the attempt at surprise fruitless. A Mexican officer who figured at the attack on the church held by Lieutenant Heywood, was found in one of the houses, wounded and unable to move, and an interview resulted with the wife of the escaped captain. She communicated with her husband, who acceded to the proposed interview, consented to give himself up, was accordingly escorted to the Cuartel at San José, and delivered himself as prisoner of war to Captain DuPont.

On the 9th of November, 1847, Lieutenant Heywood was landed at San José with twenty marines, three officers, a twelve pounder gun, and provisions for two or three weeks. The force was a comtemptible one and compromised our friends without protecting them.

On the same day the Congress, Independence, and Cyane sailed for Mazatlan, arriving on the 10th "cleared for action." The Cyane anchored close in with a spring on her cable, and the other ships anchored outside.

About 10 A. M. of the 11th, the Cyane having been moored head and stern, with her broadside on the town, the boats of the other ships were sighted rounding the point (the Congress had taken position in the old harbor and the Independence to the westward of the town). We shoved off our boats containing two companies and two guns, and drew up on the beach at 1.30 P. M., Lieutenant Page and myself commanding respectively the right and left wings. We marched up to the Cuartel and stacked arms. The American flag was hoisted on the Cuartel and saluted with twenty-one guns from the Independence; and at 4 P. M. we returned to the ship, leaving Company A and the marines as our quota of the garrison.

On the 14th I was sent in charge of a boat expedition up the Estero, but was forced to return in consequence of shoal water. We found on shore two or three small vessels burned to the water's edge, took from them two small anchors, and returned to the ship.

On the 20th a water and land expedition started at 1 P. M. for the purpose of surprising a party of the enemy quartered at Urias. The water party, under my command, landed within a hundred yards of the enemy's pickets, and at dawn of day opened fire and charged on the camp, from which the enemy was driven, several of them being killed and wounded. The land party, having fallen into an ambush of the enemy's advanced guard, were severely handled, losing about twenty in killed and wounded.

On the 26th, Lieutenant Smith, of the Dale, brought word that a party that had landed from that ship at Guaymas had been fired upon, and that Captain Selfridge was wounded. At 4 P. M. the Cyane went to sea, and after beating about the coast of Lower California for a couple of weeks, arrived at La Paz at 3 A. M. December 9. Lieutenant-Colonel Burton came off in a shore boat and told us that the enemy had made repeated attacks upon his position, but had each time been driven back with loss. We stayed at La Paz until February 12, 1848, protecting Burton, sending parties on shore almost nightly, and drilling the men in evolutions and target practice.

On the 12th of February we got under way to proceed to the relief of Lieutenant Heywood. We arrived at San José on the evening of the 15th and got out the boats. Heywood to all appearances was closely invested, a Mexican flag flying within forty yards of his defenses. The whole sailor force of the Cyane, amounting to ninety men, was drawn up on the beach at daylight on the 16th of February, ready to move under the command of the captain and executive officer. The force marched from the beach by the flank, the two companies abreast, with the field-piece slightly in advance—tactics adopted for the reception of a cavalry charge. The advanced guard of the enemy fell back as we came on and opened fire on us from the hill-tops as the head of our column reached the hamlet of San Vincento. They were soon silenced and dislodged by the warmth of our volleys; but as our men moved on they closed in our rear and poured in a hot but ineffective fire. As we skirted a sugar field, after crossing a stream, the enemy opened again from his ambuscades, but as they fired over the fences instead of through them, they invariably overshot us. We soon silenced them by a few volleys *through* the fences, and marched a hundred yards before it became necessary to brush them off again. Then we were assailed from a grove of plantains, in front and from both sides of the road, and until we reached the village, a distance of four hundred yards. Heywood, mustering all his force that he could spare from his defenses, sallied forth to our assistance, and met us as we climbed a small ridge. We entered the town and drew up in front of the Cuartel. Some of the men wandering through the town received a scattering fire from some stragglers of the enemy posted on the overlooking heights, from which they were soon driven by a well directed volley; after this we received no further annoyance and dismissed the men for food and repose.

Our force on this occasion was composed as follows:

Sailors acting as infantry (Companies A and B),	84	men.
Artillery,	5	"
Marines,	5	"
Officers,	8	"
Total,	102	men.

Our loss was four wounded, two of these very slightly.

The officers were Captain DuPont, Lieutenants Rowan and Harrison, Acting Master Fairfax, Midshipmen Shepherd, Lewis, and Vanderhorst, and Surgeon Maxwell.

The enemy's force is estimated at from three hundred to three hundred and fifty, and his loss at from thirty-five to forty.

During the advance of our little force on the Cuartel, the enemy were distinctly seen from the ship, but the chaparral and broken ground concealed our force so entirely from Lieutenant Selden, who had been left in command, that he was unable to fire without the danger of injuring friend as well as foe. After we reached the Cuartel he threw a few shells in the valley and soon dispersed the stragglers who hovered in the corn and cane fields. The enemy entertain a holy horror of the *bolas podridas*, or rotten balls, as they call our shells.

When the distressed condition of the garrison, the prompt and timely aid of the Cyane, and the handsome manner in which the affair was conducted, are taken into consideration, this may be safely set down as the most creditable affair that occurred in California. Lieutenant Heywood deserves the utmost praise for his determined perseverance and cool and unflinching courage. When we reached him he had provisions for but eight days at reduced allowance, and he had made preparations for blowing up the Cuartel previous to surrender; his auxiliary forces were in despair and had begun to treat with the enemy.

The wants of the garrison having been relieved and the wounded attended to by our fighting surgeon (Maxwell), nothing remained to mar our joy but the death of Passed Midshipman McLanahan, who fell, fighting gallantly for his country, three days previous to our arrival.

Our next duty was to bring provisions from the ship to the Cuartel, a service of much difficulty, owing to the want of suitable means of transportation and the difficulty of landing provisions in the high surf. Having procured three mules, we began packing a barrel of beef or pork on each, making two trips daily until we had supplied Heywood with two months' full rations for one hundred people. His force only amounted to sixty, including sailors, marines, and Californians, but allowance had to be made for the women and children of the auxiliaries. The operation of getting the provisions up consumed the remainder of the month. On March 1 we stopped the trains to enable Heywood to complete his well and protect it with a wall—a necessary work, since the enemy had made preparations to cut off his water, and but for our arrival would have succeeded in two or three days more.

The sloop Alerta,* Lieutenant McRae, now arrived from La Paz with the news that all was quiet there, and that Burton was planning a surprise for the purpose of rescuing our prisoners said to be in San Antonio.

March 12, we received from the whale-ship Trescot a prisoner of war, Captain Juan Zuñiga, who had recently acted as captain of cavalry under General Pineda.

March 17, the transport Isabella from Monterey hove to off the harbor with a hundred and fifty New York volunteers, from Stevens' regiment, under Captain Nagle, to strengthen the garrison at La Paz. They sailed thither in the afternoon of the same day.

March 21, Passed Midshipmen Duncan and Warley arrived from La Paz in a small launch with three men, having been rescued from captivity by Burton's surprise; the rescuing party had been composed of thirty mounted men under the command of Captain Steele, accompanied by Lieutenant Halleck of the Engineers.

On the night of March 23, Captain DuPont went with a party to surprise the enemy's camp at Santa Anita, accompanied by Lieutenant Heywocd and myself; but a spy frustrated the attempt by giving the enemy information, and when we reached the camp we found it deserted.

April 1, Lieutenant Selden, with Surgeon Maxwell and a party of mounted men (sailors and marines), was sent from the Cyane to scour the country, and returned after an absence of three or four days, bringing about twenty prisoners, but without important information.

April 16, the schooner Rosita, commanded by Passed Midshipman Duncan, arrived, bringing Lieutenant Moorehead of the Army, ten men and a wagon, preparatory to the arrival of a force for the relief of Heywood.

April 20, the brig Sterling arrived with sixty-three 8-inch mortars; and the Southampton also came in, bringing two hundred volunteers for the relief of the garrison.

Sunday, the 23d, the Cyane left San José for Mazatlan and arrived there on the evening of the 29th. On the 7th of May, the Ohio, bearing the broad pennant of Commodore Jones, came in and anchored.

After staying a week at Mazatlan we were informed that a mutiny had broken out among the New York volunteers at San José, and we

* Captured, November 3, 1847, by Lieutenant Craven.—Ed.

of the Cyane were ordered there to quell it by our presence, with instructions to use force if necessary. We got under way, reached San José, filled our water casks, and having received on board five of the mutineers, made sail again for Mazatlan, where we anchored on Sunday, May 21st.

June 1, 1848, having made all preparations for sea, we got under way, homeward bound; passing under the Commodore's quarter we saluted him, gave and received three cheers, and stood out of the harbor.

Arriving at San Blas we learned that the Mexican Congress had ratified the treaty of peace. This, of course, was the end, and my war service in the Cyane was over.

NOTICE.

As it is desirable to have a thorough discussion of the important subject of "Naval Administration," the members of the Institute are notified that written remarks pertinent to that subject will be received at any time before October 25, 1888, for publication in the autumn number of the Proceedings.

By direction of the Board of Control,

CHAS. R. MILES, *Lieut.*, *U. S. N.*,

Secretary and Treasurer.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

JUNE 6, 1888.

REAR-ADMIRAL C. R. P. RODGERS, U. S. N., in the Chair.

NAVAL ADMINISTRATION.

By REAR-ADMIRAL S. B. LUCE, U. S. Navy.

Government, in the abstract, is the operation of law, and law has been defined as a rule of action.

Naval Government may be said to be that system of rules by virtue of which the affairs of a navy are regulated.

Administration, signifying *management*, means, in a political sense, to manage and direct the affairs of Government, and belongs to the Executive as distinguished from the Legislative branch.

Naval Administration, therefore, signifies the management and direction of that part of the executive branch of the Government which pertains to the National, or Military Marine.

The rules on which a naval administration is based should be framed with a view to ensuring an intelligent direction of naval affairs, economical management, and an efficient condition of the disposable force.

The Minister of Marine, or (as in the United States) the Secretary of the Navy, is a Cabinet officer, and the lawfully constituted adviser of the Chief Magistrate on all questions relating to his branch of the public service. He is the naval administrator *ex officio*.

There are three principal qualifications necessary to a good naval administrator; viz., he should be familiar with public affairs, have an aptitude for business, and be well versed in naval matters.

To be "well versed in naval matters" implies not only a knowledge of the trade of a seaman, but of the art and science of war as well. As these qualifications are rarely found to be combined in one person, it

has been universally conceded that there must be a division of lay and professional duties; and such is the complexity of the machinery of a well devised system of naval administration, such the diversity of knowledge required, that the rule holds good whether the Minister of Marine be a civilian, or, as frequently occurs under the military governments of Europe, a member of the naval profession.

Now, it is the adjustment of the civil and military branches of administration that forms one of the prime difficulties in arranging a naval government that will satisfy the requisite conditions as already laid down. And in the effort to effect this adjustment it is necessary, and indeed proper, that there should be taken into account the great jealousy of the military and naval classes which has from time immemorial existed in the Anglo-Saxon race on the part of the civil authorities.

It would be well to premise here that as the word *Maritime* relates to affairs of the sea generally, and the word *Naval* is often used in a double sense,—as "Naval Officer" of the Custom House, "naval stores" of commerce, etc., etc.,—the word *Military* will be used throughout this article to apply to those naval matters which are of a distinctly military character, as opposed to those which are common to the military art and the mercantile world alike. Thus, *Ordnance* does not come under the head of the military branch of the naval government; for, among other duties, it is the business of the chief ordnance officer to design and construct guns and their dependencies. He is in some sort a manufacturer, and, as such, his office comes under the civil branch. He need not necessarily be a military or a naval officer. Sir William Armstrong, Sir Edward Whitworth, and Krupp of Essen, were all civilians, as were Parrott, Dr. Gatling, and Hotchkiss. *Naval Gunnery*, on the other hand, is a distinctively military art, and belongs exclusively to the military branch of naval government. The procurement of naval stores and materials, and the construction and equipment of ships, although those ships are designed for purposes of war, come under the civil administration, as do all matters of finance.

It is necessary that this distinction should not be lost sight of, for it is the key to the whole question. The character of a bureau of an Executive department is determined by its functions, not by the status of its chief. Hence, as all the bureaus of our Navy Department belong to the civil branch of naval administration, all the chiefs of bureaus act in a civil capacity. Such is the theory on which our Navy Department is constructed.

In practice, this theory is departed from to the extent of arbitrarily assigning certain military duties to two or more of these civil bureaus; but those duties are there of necessity, not of right. It may be said here, at the outset, as will be fully shown later on, that it is to this confusion of ideas, this unphilosophical, ill-considered attempt to force a union between incompatible elements (the civil and the military), that the present condition of the Navy is due.

To a thorough understanding of the question under consideration, it will be necessary to go back somewhat, to the early days of the navy of Great Britain, whence many of our laws and customs are derived.

NAVAL ADMINISTRATION IN ENGLAND.

"The guardianship of the seas, and as a consequence the command of the naval forces, is by the common law of England vested in the Crown. In early times the Crown delegated this power to officers who were first called 'guardians of the sea,' and, afterwards, Admirals."

"The office of Admiral, then, forms one of the prerogatives of the Crown, but is distinct from the kingly office, and is capable of being conferred either partially or in full on a subject."

"The appointment of a Lord High Admiral, unless restricted by the instrument of appointment, is a complete delegation of the office and vests in the appointee all the powers and privileges of the Lord High Admiral. Usually, however, a partial delegation, only, takes place by the appointment of Lords Commissioners of the Admiralty, who are invested by their commission with such powers only as are necessary for the government of the Navy. In the meantime the office is not in abeyance, but is retained by the Queen, who is *ex officio* Lord High Admiral and possessed of all the powers that are not included in the commission of the Lords of the Admiralty. To remove certain doubts, the Act of William and Mary provides that all powers of the Lord High Admiral may be exercised by the Lords of the Admiralty according to their commission, to all intents and purposes as if they were Lord High Admiral of Great Britain."

[Thring.]

The foundation of the Navy of England was laid by Henry VIII (1509–47). He constituted an Admiralty and a Navy Board. The former represented the military branch and was appointed to inspect ships of war. It was not permanent in its character. The latter

formed the civil branch and was of a more permanent nature. The Court of Admiralty was erected about the same time.

The regulations for the civil government of naval affairs were, under Edward VI, revised, arranged and confirmed by ordinances which form the basis of all subsequent instruction given to the officers to whom the management of civil affairs of the Navy has been committed.

"No considerable alteration in the civil government of the Navy took place from the time of Edward VI till 1609, when, in consequence of many abuses which were complained of, the principal officers were suspended, and commissioners appointed with powers to manage, settle, and put the affairs of the Navy into a right course, and to take such measures as they might deem necessary to prevent the continuance of the many great frauds and abuses which prevailed." [First Report of the Commissioners on the Civil Affairs of the Navy, 1805.]

THE NAVY BOARD.

Distinct from the Admiralty, yet subject to it, the history of the Navy Board serves to illustrate the great evil of separating too widely the civil and the military branches of naval government. Established in 1512, the Navy Board went through a variety of changes of organization, inflicted untold injuries upon the Navy, and was finally abolished in June, 1832. Its whole history is a standing protest against the unaccountability of boards, or of individuals, charged with important public duties and large expenditures.

The Navy Board, under the Controller of the Navy, was charged with the civil administration of the Navy. It had to do with contracts, supply of stores and provisions, work in the dockyards, etc., etc. Nominally subordinate to the Admiralty, the members of the Navy Board acted as if wholly independent of all control, and much of the waste and peculation was due to their negligence, ignorance, and incapacity. The list of abuses almost exceeds belief. During the French wars the complaints of bad provisions were general. The English squadrons blockading French ports were so badly supplied with wholesome food that scurvy was common. At the close of the Seven Years War, 1755–1762, there had been lost in killed and wounded, during all the naval battles, 1512 seamen and marines, while 133,708 had died of disease or had been driven by ill treatment to desertion.

In 1798, the Ajax line of battle ship cost to build at a private yard £20,502. In four years her repairs alone had amounted to £28,977. The Achilles, built about the same time and for about the same price, cost in repairs £37,000. It was stated on the floor of the House of Commons that in Lord Spencer's time (1794–1801) the amount of plunder and embezzlement in the Navy was fully £3,000,000 per annum, or about 25 percentum of the annual expenditure.

Lord Spencer was succeeded as First Lord of the Admiralty by the Earl of St. Vincent, and it required just such a character to bring the Navy Board to a strict account. He moved for a Parliamentary Commission to inquire into abuses in the civil departments of the Navy. The measure was violently opposed by one party in Parliament, at the head of which was no less a person than Mr. Canning; and as warmly supported by another, the staunchest of whom was Sheridan. Besides these, such eminent men as Mr. Addington (then Prime Minister), Pitt (his predecessor in office), Fox, Law (afterwards Lord Ellenborough), Grey, Lord Eldon, and Earl Temple took part in the debates. In the Peers, Lord Nelson, who had had personal experience in command afloat of the wretched inefficiency of the Navy Board, cordially supported the bill. The Navy Board was strongly represented in the House. The Controller himself, who was at the head of the Board (then Sir Andrew S. Hammond, an old officer of good standing), had a seat, and the jobbers and contractors all had their representatives. The measure was finally carried, however, in spite of the opposition.

The departments to be investigated were those of the Navy Board, the Treasurer of the Navy, the Victualling Board, the Sick and Hurt Board, the commissioners for the receipt of sixpences from merchant seamen for Greenwich Hospital, and of prize agencies. It is stated authoritatively that from 1694 to 1851 England had robbed her merchant seamen of £2,500,000 in hospital dues for which nothing had been given in return but neglect. Sick merchant seamen were never admitted to Greenwich Hospital.

The Commission was two years in session and made twelve reports, each covering a different subject. Some of the reports are said to have "astonished Parliament and the country," and the work on the whole to have been one of the most able, acute, and laborious investigations ever undertaken. On May 2, 1805, the Commission, on the motion of Mr. Sheridan, received a vote of thanks. Many reforms

grew out of this inquiry, but a change of ministry gave the Board a fresh lease, so that it was not abolished till 1832.

In this age of enlightenment such a prodigy of wastefulness as the Navy Board would be incredible were it not for the fact that almost as great a waste is going on to-day in our own Navy and under our own eyes.

THE BOARD OF ADMIRALTY.

In 1604, James I issued a Commission for "an inquiry into the general state of the Marine." This was followed in 1618 by a second Commission "for regulating the affairs of the Navy." This latter Commission was of the nature of our Advisory Board, "without whose advice no affairs of importance relating to the Navy were to be undertaken." It was composed of men of rank and naval experience, and owed its existence to the incapacity of the Lord High Admiral. This Board was the germ of the present Board of Admiralty.

During the Commonwealth, the affairs of the English Navy were managed by a Committee of Parliament, just as our own Navy was at first managed by a Committee of Congress.

On the restoration of Charles II, the Duke of York was appointed Lord High Admiral; but the Test Act of 1673 compelled him to resign his office, which was then placed in commission, the Commissioners, as before, being the great officers of state, with Prince Rupert at their head. The Commission continued until May, 1684, when King Charles assumed the government of the Admiralty personally, and retained it until his death. On the termination of his reign the Navy had sunk into "degradation and decay."*

James II, on his accession, 1685, mindful of the jealousies that had arisen between the sovereign and himself, when Lord High Admiral, as to the exercise of the large powers of that office, declared himself in council Lord High Admiral and Lord General, and personally managed the affairs of the Navy, through Secretary Pepys, until the Revolution. The title thus assumed was subsequently confirmed by Parliament.

The prostitution of the great office of High Admiral by granting it to court favorites, or placing it in incompetent hands for corrupt purposes, had the natural effect of compelling Parliament to check the abuse. Immediately after the Revolution of 1688, an act was

* For a very interesting account of the state of the English Navy at the close of the reign of Charles II, see Macaulay's History of England.

passed establishing a Board of Admiralty, legalizing in effect and rendering permanent the customary Commission of experts that incompetent ministers had long rendered necessary. By this act it was "declared and enacted that all and singular authorities, jurisdictions and powers which, by any act of Parliament or otherwise, have been, and are, lawfully vested . . . in the Lord High Admiral of England for the time being, have always appertained to, and may be exercised by, the Commissioners for executing the office of High Admiral of England for the time being according to their commissions."

As no immediate steps were taken by the Crown for the appointment of a Board of Admiralty, the question was brought up in the House of Commons two years later, when it was resolved "that it is the opinion of the Committee that in pursuance of His Majesty's speech, the House be moved that His Majesty be humbly advised to constitute a Commission of Admiralty *of such persons as are of known experience in maritime affairs ; that for the future all orders for the management of the fleet do pass through the Admiralty that shall be so constituted.*"

This statute and resolution are the original authority for the constitution of the Board of Admiralty in its present form, and it is believed to be the first formal recognition of the *military* character of the Navy, other orders and acts relating mostly to its *civil* affairs.

OFFICE OF LORD HIGH ADMIRAL.*

Sir Thomas Beaufort, youngest natural son of John of Gaunt, was appointed May 3, 1411, Admiral of England, Ireland, and Aquitaine. On his death, in 1426, he was succeeded by John of Lancaster, Duke of Bedford, third son of King Henry IV, who combined in his own person the office of Lord High Constable with that of Lord High Admiral and Regent of France. He was succeeded on his death, 1436, by John Holland, Earl of Huntingdon, afterwards Duke of Exeter, to whom, and his son after him, the office of High Admiral was granted for life, after which the succession of Lords High Admiral remained unbroken until 1628, when, for the first time, the office was placed in commission.

* The first English Admiral of the Sea was William de Leybourne, appointed in 1286. He seems to have filled the offices of Lords Commissioners and the High Court of Admiralty. These earlier offices, while interesting to read of, have little historic value, owing to their indefinite character.

The Duke of Richmond, natural son of Henry VIII, was made Lord High Admiral at the age of eight, an indication of the estimate then placed upon the high office.

James, Duke of York, was Lord High Admiral, 1660; Charles II, 1673; Prince Rupert, 1673; Charles II, 1684; James II, 1685; Prince George of Denmark, 1702–1705. On the death of the last named, Queen Anne held the government of the Admiralty in her own hands. This lasted but a short time, however, when the Earl of Pembroke was made Lord High Admiral. He resigned the office as "too heavy a load for him to bear," when it was put in commission, and remained so until May 2, 1827. The Duke of Clarence was then appointed to the office, with a council to assist him, but resigned August 12, 1828, since which time the office has been in commission.

In 1861 Sir James Graham testified before a Parliamentary Committee: "I saw a naval officer, a Prince of the blood, made Lord High Admiral, with a council, and it worked so ill that in the course of about 18 months it came to a deadlock, and the Duke of Wellington—no bad judge and no bad administrator—was forced to abolish the office of Lord High Admiral and his council, and to revive the Board of Admiralty under its present patent."

It is to be concluded from the foregoing that the title of Lord High Admiral has now become a mere fiction of law, signifying the delegated authority of the Crown; and that the best practice is to have the duties of the office executed by "persons of known experience in maritime affairs."

From the time of the Duke of Clarence to 1868, no material change in the constitution of the Board took place save to increase the membership to six.

In March, 1861, a royal commission recommended the abolition of the Board of Admiralty and the appointment of a Minister of the Navy Department. While the recommendation was not adopted, yet the report led to certain important modifications in the constitution of the Board. Thus in December, 1868, the office of Third Lord was merged with that of Controller, who now, for the first time, had a seat at the Board. The reason for giving the Controller a seat at the Board and making him the Superintending Lord for all business connected with the building and repairing of ships and engines, with guns and with naval stores, was the anomalous position he occupied by being placed under the supervision of the First Naval Lord (*i. e.*, the officer specially concerned with the efficiency and strength of the

fleet); so that, practically, the only member of the Board in a position to enforce economy in ship-building was the one who was most interested in increased expenditure.

The Board of December 18, 1868, was, therefore, constituted as follows: First Lord, First Naval Lord, Third Lord and Controller, Junior Naval Lord, Civil Lord, Parliamentary Secretary, Permanent Secretary.

The First Lord was declared (Order in Council, January 14, 1869) to be responsible to Her Majesty and to Parliament for all the business of the Admiralty, the other members acting as assistants in the transaction of the duties, which were divided into three principal heads, viz., Personnel, Matériel, Finance. The First Naval Lord became responsible to the First Lord for the administration, under his instructions, of so much of the business as related to the personnel, and for the movement and condition of the fleet.* He became, in fact, Adjutant-General to the First Lord, or Chief of the General Staff, relieving him of those purely professional duties which the average civilian fails to master.

The Third Lord and Controller became responsible for the Matériel, and the Junior Naval Lord was to assist the First Naval Lord.

The Parliamentary Secretary became responsible to the First Lord for the finance of the department, in which he was assisted by the Civil Lord; the Permanent Secretary taking exclusive charge of the secretariat under the First Lord.

That is to say, the several members of the Board form the general staff of the Minister of Marine, the chief of staff being the senior naval officer. Subordinate to the supreme head of the organization come two grand divisions, viz:

The Military, comprising the Personnel and the Fleet; and

The Civil, comprising Matériel and Finance—a division of labor of such obvious propriety as to force itself upon the conviction as being the only natural and proper one.

It will be shown, as we proceed, that this distribution of duties has never been designedly recognized in the organization of the Navy Department of the United States.

In 1872 a Naval Secretary was added to the Board, and the Controller ceased to be a member. The three Naval Lords became responsible for the personnel and the movement and discipline of the fleet, the Controller (without a seat on the Board) for the matériel,

* Fleet, as here used, means the entire floating force of the realm.

the Parliamentary Secretary for the finance, the Civil Lord and the Permanent and Naval Secretaries undertaking such duties as might be assigned to them by the First Lord.

Nov. 1, 1877, the Permanent Secretary was abolished.

April 18, 1882, the Board was again reconstituted, the Controller resuming his seat, and a non-parliamentary Civil Lord, "possessing special mechanical and engineering knowledge and experience in the superintendence of large private establishments," being added to it for the purpose of assisting the Controller in the business relating to the matériel of the Navy.

May 18, 1882, the Naval Secretary was abolished and the Permanent Secretary revived—but the office may be filled by a naval officer.

The Board meets every week day at noon, except Saturday, and two Lords and a Secretary form a quorum for business. Certain orders may be signed by the Secretary of the Board alone and are regarded as the order of the Board collectively, but an order that authorizes the payment of money requires the signature of two Lords.

From the foregoing it would appear that the Naval Government of Great Britain is similar in its constitution to that of the executive branch of our own Government; each has a Chief Executive, assisted by advisers in the several departments of the Government, each adviser having special duties in his own department, and, in addition thereto, a seat in the Council Board for the management of the body politic. Each forms an administrative body for the administration of the affairs, in the one case of the government of a country, in the other, of a navy.

This feature of the English system should not be lost sight of. The Minister and the General Staff, taken collectively (in this case the Board of Admiralty), may be considered as comprising the *military branch* of the administration. We now come to the

CIVIL BRANCH.

First, the Secretariat. The First Lord has, besides his council of "persons of known experience in maritime affairs," his own special office in which are found the Parliamentary and Financial Secretary, the Permanent Secretary, and his private secretary, generally a naval officer of the rank of captain. In what is called the Department of the Secretary there are an Assistant Secretary and some fifty-odd clerks and copyists.

Secondly, the Third Naval Lord and Controller. Under this office comes:

1. The Director of Naval Ordnance and Torpedoes, with five assistants.

2. A Chief Constructor, and corps of assistants.

3. An Engineer-in-Chief, and corps of assistants, with sundry subdivisions besides.

Then follow in order:

The Hydrographic Department and its staff of assistants and clerical force.

The Department of the Director of Transports.

The Victualling Department.

The Department of the Accountant-General of the Navy.

Contract and Purchase Department.

Office of the Admiral-Superintendent of the Naval Reserves.

Department of the Medical Director-General.

Royal Marine Office, etc.

There is one feature of the Board of Admiralty which would be impossible in the United States; this is due to the difference in the form of government. According to the British Constitution, the supreme power of the state is lodged in two principal branches, viz., the Parliament, consisting of the Crown, Lords, and Commons; and the Executive, consisting of the Crown alone. Hence the Executive forms a part of the legislative branch, and members of the Cabinet have seats in Parliament. In this way it comes that members of the Board of Admiralty may hold seats in Parliament. This enables the First Lord to present the Navy estimates in person, answer questions on the floor of the House in regard to them, define the naval policy of the Government, and defend its measures as far as the Navy is concerned. These are advantages in the transaction of public business obviously of great utility.

Among the disadvantages may be mentioned the fact that the Board changes with a change of Ministry. But this, in its turn, is offset by keeping the Board always in accord with the dominant party.

There is a certain rude efficiency in the English naval administration, the proof of which lies in the fact that, bad as it has been at certain periods, it has during nearly two centuries stood the test of great wars when the naval resources of the country have been strained to the utmost, and that, in 1861, it successfully withstood a formidable combination to abolish it.

There are certain other interesting features peculiar to the naval

government of Great Britain, but enough has been said to illustrate the general principles on which, after many changes, it has been finally based.

It may not be out of place, however, to remark here that, notwithstanding the successful administrations of Anson and St. Vincent, the best received opinion in England is against having a naval officer as First Lord of the Admiralty; while in the United States it is doubtful if the idea of placing a naval officer at the head of naval affairs has ever been seriously entertained.

FRENCH NAVAL ADMINISTRATION.

The foundation of the French naval organization was laid by Colbert, the great Minister of Finance of Louis XIV. Possessed of extraordinary business capacity, untiring energy, and great tenacity of purpose, he reduced the public debt, raised money, and brought up the Navy from mere nothingness to a formidable power. Called to the head of the Navy in 1665, he found but two or three ships in a condition for sea. The rest had either rotted on the stocks or had gone down at their moorings in Toulon. Yet in seven years he was able to send the Count d'Estrées with a fleet of forty sail to witness the battle of Solbay (May, 1672), and the Duke de Vivonne with fifty ships to conduct the celebrated campaign in Sicily in 1676. This extraordinary development of naval power, says Professor Laughton, was compared to Minerva springing from the head of Jupiter all armed for combat.

As it is not necessary to our present purpose to trace the development of the French Navy Department, a partial examination of it as it exists to-day will suffice.

The military instincts of the French people, together with their aptitude for organization, lead us to suppose that their form of naval government would, in some respects, approach the ideal; and such in truth we find it. The various civil and military duties are distributed with much apparent care and judgment.

The Minister of the French Marine may be either a civilian or a naval officer. The present incumbent (1888) is a Rear Admiral, and represents both the civil and the military power. He is assisted by an Under Secretary and a general staff of about fifteen officers, ranking from a rear admiral, the chief of staff, to a lieutenant.

The duties of the staff are divided into three sections, viz:

1st Section. Military operations.

2d Section. Military and naval intelligence.
3d Section. Defense of navy-yards.
Archives.

Next in order comes the Hydrographic Office, and then the Board of Admiralty (*Conseil d'Amirauté*), of which the Minister is president. This Board bears not the slightest resemblance, save in name, to the English Admiralty. It is an advisory board, and one of its chief duties is to prepare each year the lists of officers from which selections for promotions are made.

The Secretariat (*Cabinet du Ministre*) is divided into two bureaus, the rear admiral, chief of staff, being director.

1st Bureau. The Minister's office.
2d Bureau. Movements of the fleet and military operations.
A captain is chief of the 2d Bureau.

Personnel (*Direction du Personnel*).
A rear admiral, director.

1st Subdivision. 1st Bureau. Officers.
2d Bureau. Enlisted Men.
3d Bureau. Marine Corps.
4th Bureau. Half pay-list. Maritime Law and Justice.
2d Subdivision. 5th Bureau. Pay and Clothing.
6th Bureau. Subsistence and Hospitals.

Then follows:
Matériel (*Direction du Matériel*) and four Bureaus, etc.

There are, altogether, five *directions* (a *direction* corresponding to a bureau in our system), each *direction* having two or more *bureaus*, each *bureau* having two or more *sections*.

Among these several *directions*, *bureaus*, and *sections* are distributed, with much detail, all the business of an extensive and thorough naval administration, in which both the civil and military branches are well provided for.

The Minister of Marine is a member of the *Corps Législatif*, and is responsible to that body and to the Chief Magistrate for his acts.

U. S. NAVY DEPARTMENT.

The President of the United States is Commander-in-Chief of the Army and Navy. [Constitution of the United States.]

One of the executive departments is the "Department of the Navy," the principal officer of which is "the Secretary of the Navy,"

whose duty is "to execute such orders as he shall receive from the President of the United States relative to the procurement of naval stores and materials, and the construction, armament, and equipment of vessels of war, as well as all other matters connected with the naval establishment." [Act of April 30, 1798.]

The Secretary is, in everything pertaining to his branch of the public service, the exponent of the President, and his acts are to be considered the acts of the President, and have full force and effect as such. The official duties of the heads of the executive departments, however, are not merely ministerial—they involve the exercise of judgment and discretion (Decatur *v.* Paulding, 14 Pet. 515). He is authorized by law to prescribe regulations not inconsistent with law for the government of his department, the conduct of its officers and clerks, the distribution and performance of its business, and the custody, use, etc., of its records, etc.

The act of '98 further authorized the appointment of a principal clerk, and of such other clerks as the Secretary thought necessary.

This meager form of naval government, which recognized the civil branch alone, to the total exclusion of the military, lasted seventeen years, when it was found necessary to introduce some technical knowledge in the administration of the affairs of the Navy.

BOARD OF NAVY COMMISSIONERS.

The act of February 7, 1815, added to the department a Board of Navy Commissioners, consisting of three officers of the Navy not below the rank of post-captain, at that time the highest grade in the Navy. This was a practical application of the principle laid down by the English Parliament, over two hundred years previously, that the "management of the fleet should be entrusted to a commission of such persons as are of known experience in maritime affairs."

The act of 1815 declared that "the board so constituted should be attached to the office of the Secretary, and, under his superintendence, discharge all the ministerial duties of the office *relative to the procurement of naval stores and materials, and the construction, armament, equipment, and employment of vessels of war, as well as other matters connected with the naval establishment.*" It will be observed that the words italicized are precisely the same as those employed in the act of '98 defining the duties of the Secretary of the Navy. The Commissioners were the naval administrators *de facto.*

However good the intention of this act, the very language of it

tended to confusion. Three officers of high rank were placed in the office of the Secretary, in order, no doubt, that in the management of naval affairs he might have the benefit of their experience. They were to represent the military character of the profession, and should have borne to the Secretary relations analogous to those of the three sea lords to the First Lord of the English Admiralty, or the General Staff to the Minister of the French Marine. But the act declared that their duties were to be "the procurement of stores, etc., etc.," a species of business which belongs to the civil branch of naval administration. The result was that both divisions of labor, the civil and the military, were imposed upon the three Commissioners. This serious defect was soon to make itself manifest. As the business of the department increased, the Commissioners found themselves overburdened with work, both as to amount and variety, and they themselves were the first to realize the inherent defects of the system. They repeatedly brought the matter to the attention of the Secretary and to Congress, but for a long time their recommendations, from some cause, certainly from no fault of theirs, failed to secure attention. Defective as the system was, however, there yet existed in the office of the Secretary a wise directive force and a judicious management of the Navy as a whole, and it is generally conceded that under that management the Navy grew in strength and efficiency, and that the discipline of the service was of a high order.

But the Board became so overweighted with its double function, some of its duties being inconsistent with others, and popular opinion became so strong in favor of a change, that Congress finally took action, and in 1839 invited the Secretary of the Navy to propose a plan of reorganization of his department. The obvious remedy was to unburden the Commissioners of all but their military duties, and to place the civil functions in the hands of another set of persons whose employment should have been authorized by law. This would have assigned to the civil branch, thus brought into existence, "the procurement of stores and materials, the construction, armament and equipment . . . . of vessels of war"; leaving "the employment of vessels of war as well as other matters connected with the naval establishment," to persons experienced in maritime affairs. The "other matters" could have been justly interpreted as including personnel, and management and discipline of the fleet, and assigned exclusively to the Commissioners. Had this plan been adopted the Navy would have continued under the management

of "persons experienced in maritime affairs," and would have been a vastly different affair from what we find it to-day.

Such would have been the true solution of the difficulty. That a somewhat similar plan was in the minds of those who were most active in bringing about a change is well known. Writing in 1840, one officer says: "In remodelling the office of the Secretary of the Navy, it is proposed that all the details of the service (such as the personnel, assignment of ships, etc.) should be entrusted to a sort of Under Secretary, similar to the Adjutant-General of the Army, who shall be a post-captain." . . . . "It is proposed that the style and title of Under Secretary be that of Commissioner of the Navy; that his department be constituted like the rest, into a separate office or bureau; and that, being next to the Secretary, the Bureau of Commissioner takes precedence over all others which have been named, without any regard to the order in which they stand."*

Briefly stated, the proposition was to have the civil administration provided for by a number of bureaus, and the military confined to one commissioner instead of to three. Fortunate indeed had it been for the United States Navy if such an idea could have prevailed. But the pendulum, once released, was now allowed to swing to the opposite extreme.

The act of August 31, 1842, abolished the Navy Commissioners, and, with them, the military branch outright; provided for the civil branch alone and gave to it five bureaus, thus leaving the civilian Secretary, as far as the law was concerned, absolutely destitute of professional aid in the management of the Navy, as a unit, and of the military branch of the department.

The civil administration was provided for in the act of 1842 as follows:

"There shall be attached to the Navy Department the following bureaus, to wit:

1. A Bureau of Navy Yards and Docks.
2. A Bureau of Construction, Equipment and Repairs.
3. A Bureau of Provisions and Clothing.
4. A Bureau of Ordnance and Hydrography.
5. A Bureau of Medicine and Surgery."

The act further authorized the President to appoint the chiefs of the 1st and 4th bureaus from the list of post-captains.

* "Harry Bluff" (Lieutenant Matthew F. Maury) in *Southern Literary Messenger*, January, 1841.

In thus blocking out the business of the Department by statute, it will be observed that there is no recognition whatever of the military branch, the personnel, and the management and discipline of the fleet, offices so carefully provided for in the English and French systems; and especially is there no provision for a council of experts to shape and maintain a naval policy—in short, no naval administrators.

The train of evils following this radical defect of the law cannot in justice be laid at the door of Congress alone. The act, though faulty, was not so strictly drawn as to preclude the exercise of a large discretion on the part of the Secretary in the readjustment of the duties of his department. The language of the act is as follows:

"The Secretary of the Navy shall assign and distribute among the said bureaus *such of the duties of the Navy Department as he shall judge to be expedient and proper.*" And further, "The Secretary of the Navy shall . . . . appoint, with their consent, officers of the Navy, not above the grade of lieutenant, to perform the duty of any clerkship created by this act."

As far as we can see now, there was no reason why the Secretary should not have organized his department, under the law, in accordance with the principles which obtain in other naval governments. Congress had given him general instructions to exercise his judgment in the distribution of the duties. He could have provided, therefore, for the military as well as for the civil branch of his department; but in point of fact he provided for the latter alone, as the law seemed to suggest he should do. Doubtless he acted wisely; for to have assigned the double functions to individuals might have resulted in failure. It was possibly known that the attempt so to combine the civil with the military rarely succeeds, and the unfortunate experience of the Commissioners was yet fresh in the public mind. Hence each bureau was left to itself to discharge those duties only which were indicated by its title, and there was no one to co-ordinate the labors of the five chiefs, and their labors were not co-ordinated.

The results were such as might have been anticipated. There was no concert of action in the several parts, each going his several way; and the military duties were either very imperfectly performed, or were not performed at all. Moreover, while the affairs of the civil departments were administered, there was no one to administer the affairs of the Navy as a military arm of the Government—and therein lies the secret of the decadence of the Navy. With the single exception of the brief period of the Civil War, the Navy has been for

forty years without an administrator in its principal branch of business. It is needless to say that this decadence still goes on, and under existing conditions must continue to go on. Liberal appropriations will not check its decline, nor will the building of ironclads or the manufacture of heavy guns. There is an inexorable law of cause and effect which is utterly deaf to legislative enactments. President Cleveland struck the key-note when, in his first annual message to Congress, he said: "The conviction is forced upon us with the certainty of mathematical demonstration, that before we proceed further in the restoration of a Navy, we need a thoroughly reorganized Navy Department."

Of Hamilton it is said, in relation to the organization of the Treasury, 1789: "These intricate problems"—financial—"were solved at once, the machine constructed, and the system of accounts devised and put in operation; and so well were those difficult tasks performed that they still subsist, developing and growing with the nation, but at bottom the original arrangements of Hamilton." Calhoun, as Secretary of War under Monroe, found the War Department in a state of unutterable confusion. "Into this chaos he soon brought order, and the whole service of the department received an organization so simple and, at the same time, so efficient, that it has, in the main, been adhered to by all his successors, and proved itself capable of standing even the test of the Civil War." But there appeared no one, in those early days, to comprehend, or at least to put in operation, a good business method of naval administration; and long custom has so imbedded into our system the present one-sided plan, that nothing but a war, or an act of Congress—both very remote contingencies—can change it.

The act of July 5, 1862, increased the number of bureaus to eight. But some of the most serious evils attending five independent bureaus were only aggravated by increasing the number. Working on independent lines, with no professional head to look to, with no system of accountability, the Chief of Bureau found himself absolute in his own domain. His power was unlimited, and as the lines of demarcation were not always clearly defined, it was not impossible that he should go beyond his own limits and trench upon other grounds. Within his own sphere he is invested by law with the authority of the President himself, and his mandates none can question. The act of '42 declares that "the orders of a chief of bureau shall be considered as emanating from the Secretary himself, and shall have full force and

effect as such." But as the orders of the Secretary are to be regarded as the orders of the President, the orders of a chief of bureau must also be regarded as the orders of the President. This practically makes nine Secretaries, with powers in that department equal to those of the constitutional Commander-in-Chief.

THE "BUREAU SYSTEM."

Every form of naval administration must provide for a distribution of the duties inseparable from the management of the naval forces of a country; nor does it matter whether the offices to which the several groups of duties are assigned are called *bureaus*, *sections*, or *subdivisions*. Hence, whatever change may be made in the organization of our Navy Department, we must still have bureaus or their equivalents, although the distribution of duties among them may be different from what we now find it. The objectionable feature of the so called "Bureau System," as it exists to-day in our Navy Department, is that it permits each of the eight officials who constitute the Bureau system to manage his own share of the Navy independently of the others, leaving those parts which do not fall within the limits of that system not managed at all. It is just here where the Bureau fails; for, however potent in his own particular field, the Bureau Chief is powerless beyond the narrow limits of his own office. Hence the difficulty a Bureau experiences of carrying out a policy dependent for its success on the co-operation of any other Bureau. This accounts for the well recognized fact that while each individual Bureau of the Navy Department is progressive in its character, the tendency of the Navy as a body has been retrogressive.

Let us take for an example the same illustration with which we began. The Bureau of Ordnance is a civil office, while naval gunnery, as a military art, would naturally belong to the military branch of our Navy Department if the latter were properly constituted. But as this division of duties has been wholly excluded from our organization, naval gunnery falls perforce to the Bureau of Ordnance, and that bureau does everything in its power to promote good gunnery in the Navy. But its power after all, when compared to the entire body of the service, is quite limited, hence its failure to accomplish certain desired ends. For many years past that bureau has been advocating the establishment of a gunnery ship. The idea was suggested, if my memory serves me, as long ago as when Commodore Morris was chief of the bureau; and now to-day we find the present

very able Chief recommending the same thing. He knows, by the light of two past failures with gunnery ships, that it is impossible for his bureau to keep up an establishment, however admirable (and no one can say that a School of Gunnery is not one of the crying needs of our service), that depends on other bureaus for its maintenance.

So the Chief of the Bureau of Ordnance, in his last annual report to the Secretary of the Navy, recommends the establishment of a Gunnery Ship. The Secretary in his annual report passes the recommendation along to the President, and the President passes it to Congress, Congress to a Committee, the Committee to a sub-committee, and the sub-committee to a pigeon-hole—and the Navy gets no Gunnery Ship. The most curious part of it all is that this melancholy farce, if the expression may be allowed, has been going on for so many years and is still allowed to go on.

The history of the Apprentice system furnishes another illustration. It belongs exclusively to one bureau—not to the Navy Department, be it remembered, but to one-eighth part of the Department. It is an unequalled task to keep it afloat and the system has to suffer in consequence, for the bureau can carry it just so far on its way and no further. Hence our apprentice system can attain a certain degree of efficiency, but there it stops. It never has been expanded to its full capacity, and never can be until there is some directive force in the Department that will dominate all the bureaus and make them work in harmony for one end common to all. When that day comes, if indeed it ever should, we shall not hear of these various plants belonging to the different bureaus, but they will all come under the Navy Department, which will then cease to be the intangible thing it is now.

To say that this concession of independent authority to subordinate officers is a violation of the plainest military principles is nothing. But that a national legislature whose watchwords for one century have been "economy" and "retrenchment," should have complacently submitted during forty years to a system which ensures the greatest extravagance in the expenditure of public funds with the least amount of returns, exhibits one of those extraordinary instances of inconsistency which, while it excites our astonishment, defies any reasonable explanation.

It has been authoritatively stated that there have been wasted upon the Navy during the seventeen years following 1868 about seventy millions of dollars. This, allowing eighteen millions as the average

annual expenditure, would make an annual waste, due to a bad system, of twenty-two percentum of the cost—not far behind the English Navy of 1800 when the waste due to a bad system, combined with wholesale peculation, was twenty-five per cent.

The effect of this system of non-administration has not only cost us a fleet of fighting ships, but its inevitable tendency to disorganization has materially injured the tone and discipline of the personnel.

The remarks of Major-General Schofield, U. S. Army, in regard to the War Department, are so applicable to the Navy Department that they are transcribed in full. In his official report, dated Governor's Island, N. Y., September 20, 1887, the General says, under the head of

MILITARY ADMINISTRATION.

"This country appears to have inherited from Great Britain the notoriously bad system of military administration peculiar to that country, characterized by excessive centralization. In defiance of the fundamental principle upon which the Government of the United States was founded, and in spite of the manifold evils which resulted from it, that system was adhered to, with some slight modifications, until the year 1864, when it was wholly set aside at the earnest demand of General Grant. After the end of the war the discarded system was gradually restored, step by step, until it has at length been re-established in its extremest form. It is, I believe, agreed among all military men that this system of administration is wholly inapplicable to a state of war, and that it is impracticable to set aside an old system and make another immediately effective when war begins. And this is true, as experience has shown in this country, in spite of the fact that our staff organization, though perhaps not perfect, is very good, and not surpassed, if equalled, by any other in the character and ability of its personnel.

"Under this system, the Commander-in-Chief of the Army, provided by the Constitution, and the subordinate commanders assigned by him to command the army and the several geographical divisions and departments, are practically superseded by the chiefs of bureaus of the War Department.

"A decision of the Supreme Court (13 Peters' Reports) defining the *administrative* authority of the Secretary of War, having been heretofore so construed as to also sanction the exercise by the Secretary of the *military* and, in some cases, it seems, even the *judicial* functions of the President as Commander-in-Chief of the Army, the

principle enunciated in that decision has, at length, been applied to the relations sustained by the chiefs of the several bureaus of the War Department to the Secretary of War, and through him to the President. Thus the chiefs of the several Staff departments have become the representatives of the Commander-in-Chief of the Army, clothed with all his authority in respect to the affairs of their respective departments. Their orders must be respected and obeyed as the orders of the Commander-in-Chief. Supplies or means of transportation which, in the opinion of the Commanding General and his subordinate officers, are unfit for the military service, may be forced upon the troops in spite of their protest, at the dictation of a staff officer in Washington; or, those provided for special service may be diverted to other uses without the consent or knowledge of the Commanding General, or that of any superior military authority. . . ."

"This theory of military administration, of which the extreme is the multiple representation of the Commander-in-Chief, in the persons of the several chiefs of bureaus of the War Department, has been steadily opposed by all the eminent generals who have commanded armies in this country; and it is, I respectfully submit, self-evident that the military operations cannot possibly be conducted with success under such a system of administration. Yet this theory seems now to have become established as the military law of the country.

"The uniform answer to all protests against the perpetuation and re-adoption of this system, in the various stages of its development during the last twenty years, has been that it is the law of the United States. Hence it seems that Congress alone has the power to remedy an evil which all military men in this country have uniformly regarded as very serious."

These observations apply with singular force to what is popularly known as the "Bureau System" of the Navy Department.

The common remark that the Navy Department, as at present constituted, successfully carried the Navy through a great war, has just enough of the semblance of truth in it to impose on those not familiar with the facts. It is not so. Under the pressure of a great national crisis, the Department changed its organization in the direction suggested by theory, only to relapse when the pressure was removed.

One of the historians of "the Navy during the Rebellion" justly remarks: "The vast operations of the department were divided into two great branches, one relating to affairs belonging particu-

larly to the Navy, and perhaps more specifically to professional matters, and the other embracing civil transactions and the whole business machinery of the department. At the head of the first named of these divisions was placed the Assistant Secretary, who, having been himself an officer of the Navy of long experience and acknowledged skill, was supposed to be a competent judge of such plans as might be proposed for increasing the efficiency of the Navy." "As the Secretary could not be expected to study the wants of each of the several bureaus, it was one of the functions of the Assistant Secretary to arrange and combine the operations of all the bureaus and present them in a general view for the consideration and decision of the Secretary himself."

The Assistant Secretary, in short, was the "one commissioner" or "Under Secretary" suggested in 1841. The exigencies of war had demonstrated the necessity for just such an office, and it was authorized by the act of July 31, 1861.

Mr. Welles, before being called to the Navy Department as Secretary, had enjoyed the advantage of three years' experience as a chief of bureau. He was therefore familiar with departmental work and had a large acquaintance with naval officers. But, well equipped for the office as he was, the services of Captain Fox were indispensable. He filled the gap, or supplied the "missing link," between the Secretary and the bureaus, the need of which had been felt for the twenty years previous to the war, and has wrought so much evil during the twenty years following. The office was abolished in 1869. Filled from civil life, after the resignation of Captain Fox, its character was changed, its usefulness was destroyed, and its loss was unregretted.

CONCLUSIONS.

Having now examined the construction of two of the best forms of naval government, and that of one of the very worst, we are in a position to offer a few critical remarks on each.

The resolution passed by the English House of Commons in 1692, to the effect that "His Majesty be advised to constitute a commission of the Admiralty of such persons as are of known experience in maritime affairs; that for the future all orders for the management of the fleet do pass through the Admiralty that shall be so constituted," must ever form the basis of a sound naval government.

The privilege enjoyed by the Admiralty of being represented in the national legislature is a very great advantage to both the legisla-

tive and executive branches of the Government, and greatly facilitates the transaction of public business.

The division of the business into the two branches of civil and military is indispensable to every good form of naval government.

English naval administration, while conforming in the main to sound principles, is not, on the whole, such as to recommend itself to imitation.

The constitution of the French naval government is more symmetrical, and shows throughout a clear conception of the requirements of naval administration and a purpose to supply them, while each, the English and the French, is, in its own way, organized for war. The naval administration of the other maritime powers does not materially differ from those just given.

On looking into the constitution of the U. S. Navy Department, one is struck at the first glance with its utter incapacity for dealing with the problems of war, or with military questions in general. At the first note of war it would have to undergo a radical change, as it did in 1861. The military branch now wanting would have to be supplied.

Another notable point is the difficulty in formulating a naval policy and placing it before Congress. The only recognized method is by written communications from the Secretary of the Navy, which are little read. The Constitution declares that the President may "require the opinion in writing of the principal officer in each of the executive departments upon any subject relating to the duties of their respective offices." This clause has given rise to the annual departmental reports which accompany the President's message to Congress. On reaching Congress, the message and the various reports are referred to appropriate committees. The report of the Secretary of the Navy, accompanied by the reports of the chiefs of bureaus, goes to the Naval Committees of the two houses, and is then referred to sub-committees. The sub-committee consists of three or more gentlemen trained in civil pursuits, and unfamiliar with military or naval affairs, and it is an open question how they will regard the various recommendations made by the Secretary and his eight chiefs. If the experience of several generations furnishes any criterion, the recommendations will receive no attention whatever. Why should they? In the whole mass of documents there are so many recommendations, and of such various character, that it is simply impossible to adopt them *en masse*, particularly as some

are often seen to be inconsistent with others, and there is no one to cull out the more important items, explain their nature and urge their adoption; consequently they are all passed over in silence. And this has been going on for years, till the more experienced bureau chiefs are beginning to abandon the hopeless task of recommending measures that are never even considered.

Within the last few days a statement has been going the rounds of the press which, if true, confirms this. The chairman of the House Naval Committee, when asked recently the cause of the inactivity of the committee in the matter of legislation for the Navy, said: "It is difficult to determine what is desired by naval officers or needed by the Navy. All want something different, and to ascertain what is most desirable of all the schemes submitted is akin to impossible."

The statement may have no foundation in fact, but it *sounds* as if it might be true—and I am inclined to think it *is* true.

It happens occasionally that an officer of the Department may, by personal solicitation, impress the Naval Committee with his own individual views, and even enjoy the honor of having his bill "printed" and "referred," or his suggestions, urged in person, may be adopted and embodied in the naval appropriation bill; but this course is outside the regular mode of procedure. In certain important cases the Naval Committee may invite officers to appear before it and give their views on subjects under consideration. These exceptions to the rule only illustrate the necessity of having some recognized method of personal communication between the two branches of the Government.

By the act of Sept. 2, 1789, it was provided that the Secretary of the Treasury might be "required to give information to either branch of the legislature, *in person* or in writing, respecting all matters pertaining to his office." This authorization to appear on the floor and address either House has never, it is believed, been taken advantage of by the Secretary of the Treasury.*

It is not probable that a Secretary of the Navy of the present day would avail himself of such an opportunity, even were it accorded to

* When Mr. Pendleton introduced his resolution in favor of giving Cabinet members seats in Congress, General Garfield, then in the House, was among its most earnest supporters. The instance is cited to show that the evil referred to has been recognized by some of our most prominent statesmen, and efforts to remedy it have been received with favor.

him by law, unless he had already served in the national legislature. But it is not unreasonable to suppose that a plan might be devised by which a representative of the Secretary might go before the Naval Committee and address it in person, explaining the estimates and advocating the measures proposed. It has happened more than once that propositions emanating from the Navy Department have met with opposition from the Naval Committee till a full and clear explanation has silenced all opposition and secured unqualified approval. Personal communication between the legislative and the executive, instead of being the exception, should be the rule.

But by far the most striking feature of our naval government is its deficiency in the military branch, as already stated. The civilian Secretary is left entirely alone to wrestle with that division of his labors as best he may. Numerous technical questions come up for his consideration which cannot properly be referred to any one of the eight bureaus—questions which belong to the Secretary's office alone, and which should be decided in his office. He turns to one bureau chief and gets one opinion; to another and gets another opinion. Consulted independently, each regards the question from his own standpoint, mostly, and quite naturally, from the standpoint of his own bureau, which is not always that of the other bureaus or of the general service. Moreover, these questions are often foreign to the duties of the bureau chiefs, and may refer to subjects to which they have given little attention. This is far from encouraging to a Secretary new to office, and he will look in vain for that portion of the organization of his department to which he can properly refer the great mass of technical details which now absorbs so much of his time, to the exclusion of the civil affairs peculiar to his office. In short, a Secretary of the Navy is, from the very moment of his entering upon the duties of his office, placed in an utterly false position.

From the foregoing we are enabled to deduce the several principles which should obtain in the organization of a naval government:

1. At the head of the Navy should be a statesman of good business capacity.

2. He should have the option, afforded him by law, of communicating personally, or by proxy, with Congress, or a committee thereof.

3. He should have an assistant in the capacity of a Chief of General Staff to consult on all matters of a professional nature.

4. He should have an assistant to keep him advised of the civil affairs of his department.

5. He should have a solicitor to advise with on all questions of civil law that may arise.

6. The business of his department should be divided into two principal parts; viz., the MILITARY and the CIVIL.

7. At the head of the military branch should be the Secretary of the Navy himself, supported by a General Staff, the chief of which should be an officer of rank.

8. Under the military branch should be included all that relates to the personnel of the Navy,—officers, enlisted men and boys, and the marine corps; all that relates to ships in commission, their employment, efficiency and discipline; the instructions issued to commanders-in-chief, and to officers on independent service; the records of officers, their promotions and retirements; the administration of naval law and justice; all educational institutions for officers, enlisted men and boys; naval intelligence; the periodical inspection of State school ships, when officered from the Navy, etc., etc.

9. The staff should be sufficiently numerous to admit of a just distribution of the various duties. It should include the ranking officer of the Marine Corps, an officer to discharge the duties of Judge Advocate General, and a Gunnery Officer.

10. At the head of the Civil branch should be the Secretary of the Navy. This branch should include *Matériel* and *Finance*, and have to do with the procurement of naval stores and supplies of all kinds; the construction, armament and equipment of ships; engines and their dependencies; ordnance; hydrography; navy-yards; provisions and clothing, contracts, purchases, and all matters relating to finance; all that pertains to navigation; transports; civil law; medicine and surgery; hospitals, etc., etc.

11. The construction, equipment, and repairs of ships, and of engines and their dependencies, should come under one supervising head.

12. The Secretary and the principal officers of the department should meet daily, except Sundays, for consultation, and no important work should be undertaken until after it has been freely discussed by a full board. A record should be kept of the proceedings, minutes made of all orders given for the building, repairing and fitting out of ships, for the construction and repairing of boilers and engines, etc., and the votes of those present recorded.

13. Each day before proceeding to business, the proceedings of the day previous should be read over and approved, and each day's record should be signed by the recorder.

14. In the absence of the Secretary of the Navy, the Chief of Staff should preside at the board.*

15. All orders issuing from the Navy Department should be signed by the Secretary, or "by his order."

An act should be framed to cover these several points, and all laws or parts of laws inconsistent therewith should be repealed.

It is believed that a Navy Department organized in accordance with the foregoing general plan would ensure a sound and economical administration of the affairs of the Navy, and maintain in a state of efficiency such force as Congress in its wisdom should provide for.

* In the absence, I mean, from the board room. When the Secretary of the Navy is absent from Washington, his office should be filled by the civilian assistant. Were a bill to be reported in the House to-morrow, providing for an Assistant Secretary of the Navy, there would be 334 members rise and cry out, "Provided the appointee be a civilian." And they would be right. For if the principle is admitted that the Secretary of the Navy should always be a civilian, wherein consists the philosophy of violating that principle during a month or six weeks every year when the Secretary goes off for a holiday?

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

COMPARISON OF HOTCHKISS AND HEBLER RIFLES, WITH ARGUMENTS FAVORING THE REDUCTION OF CALIBER.

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The attention of foreign governments has been called, in the past few years, to the development of small arms. A great many proposed changes have been discussed, and amongst them, that of reduction of calibers.

On this subject little has been said in this country, and that little, as might have been expected, has generally been adverse to the new arm.

This paper will attempt the comparison of the ballistic powers of the Hotchkiss Navy Rifle with those of the Hebler. The data for the two weapons are as follows:

	Hotchkiss.	Hebler.
Initial velocity,	1350 f. s.	1850 f. s.
Wt. of bullet $= w$,	405 grs.	224 grs.
" " charge,	70 grs.	83 grs.
" " cartridge (complete),	640 grs.	521 grs.
" " rifle,	8.95 lbs.	9.9 lbs.
Length of bullet,	2.4 calibers.	4.46 calibers.
Caliber,	.45	.295
$\frac{d^2}{w}$	3.499	2.722

The Hebler bullet is steel covered.

The data need a word of explanation. The bullet of the Hebler rifle has beyond a doubt attained a velocity of 1968 f. s., but there is no confirmation of this by official trial; consequently in all the

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calculations the velocity used is 1850 f. s. In no way does this article uphold the Hebler as the best small arm of reduced caliber, but, owing to the exhaustive trials held with this rifle, data were obtainable. It may be mentioned here that the Pieri (cal. .323) and Lobell (cal. .307) have attained a velocity of over 2000 f. s.

The following results have been computed by ballistic tables, using Mayevski's laws of resistance of the air. The arc of the trajectory has been considered equal to a chord, and for purpose of comparison this will be sufficiently accurate; the assumption will, however, be prejudicial to the Hebler, for its trajectory is flatter. The final velocity and energy for each range will be relatively greater and the time of flight less for the Hotchkiss.

TABLE I.

Range.	I. Final Velocities.		II. Total Energy in ft.-lbs.	
Yds.	Hotchkiss.	Hebler.	Hotchkiss.	Hebler.
100	1190	1662	1272	1371
200	1080	1492	1048	1105
300	1002	1341	902	893
400	942	1214	797	732
500	890	1119	712	622
800	762	946	522	444
1000	691	866	429	372
1500	541	712	263	252
2000	*419	588	158	172

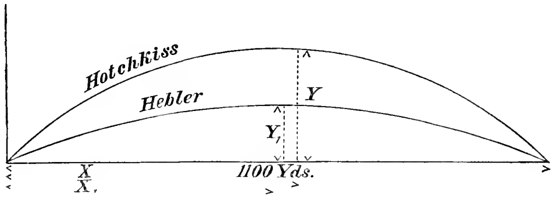
Range.	III. Energy per Unit of Cross Section.		IV. Time of Flight.		V. Energy per Unit of Circumference.	
Yds.	Hotchkiss.	Hebler.	Hotchkiss.	Hebler.	Hotchkiss.	Hebler.
100	7998	20,053	...	...	901	1474
200	6589	16,167	...	...	743	1188
300	5672	13,062	0.79	0.57	640	960
400	5012	10,705	...	...	565	787
500	4474	9,095	1.43	1.06	505	669
800	3280	6,500	2.53	1.95	370	477
1000	2697	5,447	3.35	2.62	304	400
1500	1653	3,682	5.80	4.54	186	270
2000	992	2,511	*9.05	6.86	110	180

Penetration in white pine of Hotchkiss: At muzzle, 21 inches; 1200 yards, 3.7 inches.

*Approximate.

Penetration in fir-wood of Hebler: At muzzle, 39.4 inches; 2700 yards, 2.75 inches.

A penetration of one inch in wood corresponds to a dangerous wound.



Horizontal scale, ½ in. = 100 yds. $Y = 61$ ft., $X = 600$ yds.
Vertical scale, 6 ins. = 100 yds. $Y_1 = 27$ ft., $X_1 = 570$ yds.

By reference to the table it will be seen that the final velocities of the Hebler at all ranges are greater than those of the Hotchkiss. Column II. shows the total energy to be nearly the same at all ranges for the two rifles, but there is little inference to be drawn from it. The work wanted of a small arm is penetration; the energy per unit of cross section or per unit of circumference is a fair measure of penetration, and columns III. and V. show a great superiority for the Hebler. It will be noticed above that at the muzzle the penetration of the Hebler is twice that of the Hotchkiss: at 2700 yards, 2.75 inches, as compared to 3.7 inches at only 1200 yards. The times of flight will be referred to later in connection with drift and retardation.

Perhaps the greatest advantage of all possessed by the Hebler is a flatter trajectory. A flat trajectory means greatly increased dangerous space, larger under- and over-estimates of the range allowable, and generally less care in the adjustment of the sights (not less care in sighting), and in active service this would not be an unimportant item.

The full benefits of this increased dangerous space would be most felt, perhaps, in cases of a night attack, or in any case where the objects were obscured. An increase of the point-blank range is, of course, of the greatest value. This subject has been so well ventilated, and the great advantage of a large dangerous zone is so well known, that no further mention of it will be made in this paper. The above diagram, representing the trajectories of the Hotchkiss and

Hebler rifles for a range of 1100 yards, shows the great superiority of the latter rifle in this respect.

The table and diagram then show the following advantages as possessed by the Hebler:

Greater range $\begin{cases} \text{Hebler sighted for 2843 yards.} \\ \text{Hotchkiss " " 1200 "} \end{cases}$

Greater dangerous space.
Greater penetration.
Shorter time of flight.

To these may be added decrease in the weight of ammunition and reduction of the factor $\frac{d^2}{w}$.

Now, it is held by many that these advantages follow from the better motive force in the Hebler, or, in other words, from the improved Hebler cartridge, either in its composition or shape. It has even been stated that this motive force is over double that of the American rifle. This statement, unless carefully sifted, would give the impression that reduction of caliber has very little to do with the better ballistic results given by the Hebler rifle, and that by improving the American cartridge we could get the same results with our large caliber.

The velocity formula for small arms, supposing all the powder to be burnt in the gun, is

$$v = A\frac{f^{\frac{1}{2}}}{p^{\frac{1}{2}}} c^{\frac{1}{4}} \Delta^{\frac{1}{4}} \varpi^{\frac{3}{8}} u^{\frac{1}{8}},$$

where $A =$ constant, depending only on units used.
$f =$ force of the explosive used.
$p =$ weight of projectile.
$c =$ caliber.
$\Delta =$ density of loading.
$\varpi =$ weight of charge.
$u =$ travel of the projectile.

Assuming the density of loading and the travel of the projectile the same in the two rifles compared, and inserting our known quantities, we have:

(1) $$1350 = A\frac{f^{\frac{1}{2}}}{405^{\frac{1}{2}}} .45^{\frac{1}{4}}\, 70^{\frac{3}{8}} \Delta^{\frac{1}{4}} u^{\frac{1}{8}}.$$ (Hotchkiss.)

(2) $$1850 = A\frac{f^{\frac{1}{2}}}{224^{\frac{1}{2}}} .295^{\frac{1}{4}}\, 83^{\frac{3}{8}} \Delta^{\frac{1}{4}} u^{\frac{1}{8}}.$$ (Hebler.)

Dividing (2) by (1):

$$\frac{f^{\frac{1}{2}}}{f^{\frac{1}{2}}} = \frac{1850 \times 224^{\frac{1}{2}} \times .45^{\frac{1}{4}} \times 70^{\frac{3}{8}}}{1250 \times 405^{\frac{1}{2}} \times .295^{\frac{1}{4}} \times 83^{\frac{3}{8}}} = 1.06\,.$$

Therefore the force of the Hebler explosive is not materially different. The quantity f used in the formula may be defined as the pressure per square inch developed by the gases evolved from unit weight of the explosive, the condition being that these gases occupy unit volume.

This quantity f, then, can be changed only by altering the proportion of ingredients, or changing the ingredients altogether.

The conclusion to be drawn, then, from the above result is that the *composition* of the Hebler charge is very similar to our own, or, if there is a change, very little if any additional velocity is gained thereby.

Where *all the powder* is burnt in the gun, the *shape* of the grain has no influence on the velocity. For any given weight of charge and length of barrel there will be a given volume of gas evolved, making a certain number of expansions; therefore the work done must be constant; hence the velocity will be constant with a bullet of fixed weight. The above formula for velocity, taken from "Velocities and Pressures in Guns," Vol. XIV., No. 2, page 402, Proc. U. S. Naval Institute, as can be expected, contains no coefficient depending upon the form of the grain. The reason for this change of shape is obvious: it is to get a large mean pressure with a small maximum. The Hebler charge is a pierced cylinder of compressed powder. All other elements of loading being the same, the maximum pressure varies directly as a coefficient depending on the form of the grain (whether the powder is all burnt in the gun or not); this quantity, for a spherical or cubical grain, or for any irregular shape approaching them, is 3. For any pierced cylindrical grain burning from inside and out, this coefficient is $1 + x$, where x is the ratio of the least to the greatest dimension of the grain. For the Hebler charge this is not quite 1.2. If the grain burns from the inside alone, the coefficient will be still smaller. The calculated pressure of 83 grains of loose powder in the Hebler rifle is about 34,000 pounds per square inch, loose powder being considered spherical in shape. The pressure we would then expect to find, using the compressed cylinder, is $\frac{1.2}{3} \times 34{,}000$, or 13,500 pounds. The actual

measured pressure in the Hebler gun is 7.32 tons, or about 16,350 pounds per square inch.

It has been stated that if the motive force were increased in the Springfield (caliber .45) in the same proportion that now holds in the Hebler, the initial velocity of the former would be 2008 f. s. Let us grant for a moment (but only for a moment) that this is so. The recoil would be entirely too violent, approximating 22 ft.-lbs., or twice what it now is. Suppose, again, we could give the Hotchkiss bullet a velocity of 1800 f. s., the recoil in ft.-lbs. with our 405-grain bullet would be 19 ft.-lbs. It is at present about 11 ft.-lbs. It is a very evident fact that the initial velocity cannot be increased with a limited recoil without increasing the weight of the rifle, which is already at its maximum limit. Army officers, it is believed, generally concede that the present recoil (11 ft.-lbs.) is quite large enough. Recruits suffer with this, and even trained soldiers have been more or less badly knocked up after a skirmish drill where a given number of shots must be fired while advancing a certain distance.

The resistance of the air varies directly as the factor $\frac{d^2}{w}$, and in the two arms compared, its value is 3.5 and 2.7 respectively for the Hotchkiss and Hebler. To reduce this value of 3.5, the weight of the bullet must be increased or *the caliber decreased.* Referring once more to the velocity formula, then, it is seen that the velocity varies inversely as the $\frac{1}{2}$ power of the weight of the bullet. If this is 500 grains, the new factor $\frac{d^2}{w}$ will be 2.8, and the new velocity about 1220 f. s.

As long, then, as the caliber is to be .45, to reduce the value of $\frac{d^2}{w}$ to that which now obtains in the Heber rifle, there must be a sacrifice of over 100 f. s. in the velocity. This will probably heighten the trajectory and decrease the dangerous space.

Another objection raised to reduction of caliber is increased drift due to side wind, owing to lightness of bullet. In the Proceedings of the Royal Artillery Institution, March, 1888, appears a paper, translated from the German by Major W. McClintock, R. A. An account is given therein of experiments made in England with rifles of various calibers, the result of which was the abandonment of trials with the smallest caliber. The paper then says, "A further reason for this decision lies in the fact that with the smaller caliber the bullet has

a less surface of longitudinal section, and therefore the greater effect of a side wind was feared (!)" Major McClintock appends a justly sarcastic foot-note, "there is something wrong here."

Let it be remembered, before investigating this point, that a known error can be compensated.

The retardation is proportional to $\frac{d^2}{w}$; the drift will then be proportional to $\frac{dl}{w}$ (where l is the length of the bullet), for dl will represent the cross-section presented to a side wind. For the two rifles compared, the ratios $\dfrac{\frac{dl}{w}}{\frac{d'l'}{w'}} = .6556$. Now this represents the ratio of the drift in feet *per second.* For 2000 yards, for example, the times of flight are 9.053 seconds and 6.863 seconds (see table); consequently the actual amount of drift in feet for this range will be in the following ratio, $\frac{.6556 \times 9.053}{6.863} = .865$. If a wind caused 20 feet drift in 2000 yards to the Hotchkiss bullet, the Hebler under the same circumstances would drift 23 feet. For 1000 yards the ratio would be .838, 5 feet in the former, 5.9 feet in the latter. The accuracy of the two arms is rather a difficult matter of comparison. The measure of the accuracy of the Hebler is given by the height, breadth, and radius of 50 per cent of hits; for the Hotchkiss, the mean absolute error. If this radius of 50 per cent of hits is the *probable* error—which seems very doubtful—then the comparison is made easy at once, for the probable error is about .8 the mean error.

TABLE II.

Hebler.		Hotchkiss.	
Range. Yds.	Radius 50 per cent hits. Inches.	Range. Yds.	Mean absolute error. Inches.
328	6.2	3000	4.9
656	11.0	600	14.0
984	18.6	900	25.6
1313	44.6	1100	35.2

At 600 yards the radius of 50 per cent hits would be then nearly 10.2 inches. If this be considered the probable error, then the mean absolute error of the Hebler at 600 yards is $\frac{10.2}{.8} = 13$ inches, as compared with the Hotchkiss error of 14 inches.

The strongest argument against reduction of caliber is loss of power, and as long as we cling to worn-out ideas this cannot be disputed. This loss of power is due to the fact that to keep the pressure per square inch down to the elastic strength of the metal of the barrel, the total effective pressure on the base of the projectile must be lowered. But those who have argued against reduction of caliber have generally made the most out of this. It is not always mentioned that (1) keeping the weight and length of the barrel constant, the thickness of the smaller caliber rifle is greater, or (2) the weight and thickness being constant, the length is increased.

1st. Considering the mean thickness of the Hotchkiss as 0.22 inch, that of the Hebler would be 0.264 inch. The pressure in the former rifle is 19,000 lbs. per square inch.

If $\theta =$ elastic strength of the metal,
$R_1 =$ exterior radius,
$R_0 =$ interior radius,
$P =$ maximum internal pressure per square inch;

then for a homogeneous cylinder with no initial tension, considering the atmospheric pressure as zero, Claverino gives the following formula:

$$P = \frac{3\theta\,(R_1^2 - R_0^2)}{4R_1^2 + R_0^2}.$$

Now, since the weight and length of the two barrels are to be the same, the difference of squares of the radii must be constant; therefore

$$\frac{P'}{P} = \frac{4R_1^2 + R_0^2}{4R_1'^2 + R_0'^2}.$$

If $P = 19{,}000$, then by substitution $P' = 23{,}000$ lbs. per square inch.

A working pressure of 4000 pounds per square inch more can be put on the smaller rifle.

2d. If the weight and *thickness* are constant, the length can be increased about one fifth. The muzzle energy is Pl; therefore increased travel means more work. It means a great deal more at the present day; it admits of the use of a more progressive grain. Again, a larger charge can be burnt, and the velocity, it must be remembered, varies as the $\frac{3}{8}$ power of the charge. This increased weight of powder can be used without undue strain by changing the shape of the grain, as has been done in the Hebler cartridge.

Fouling of the bore is still another disadvantage claimed by the believers in large calibers. Professor Hebler maintains that the steel covering polishes the bore, thus enabling the barrel to better resist

the chemical action of the gases, and prevents leading. He fired 1500 rounds and there was no wear on the grooves.

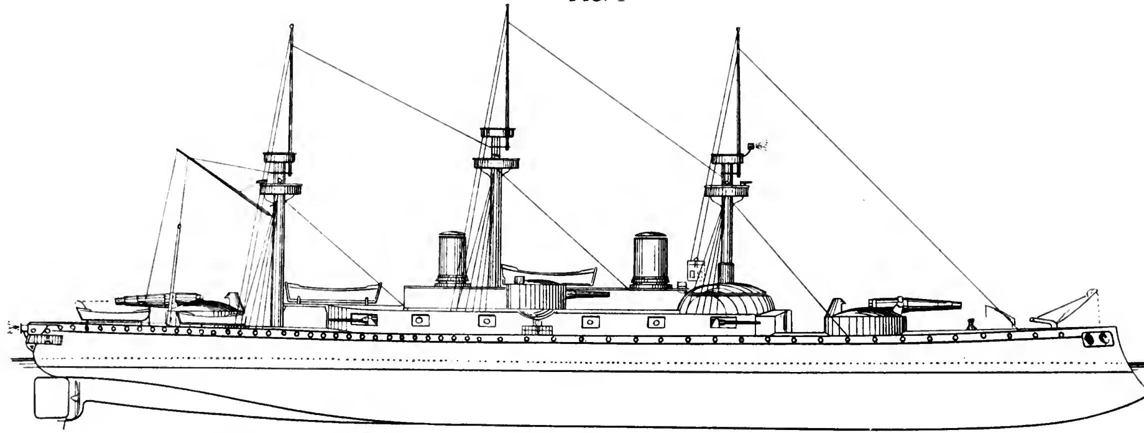
Actions in the future will begin at greater ranges, small-arm fire commencing at from 2000 to 2500 yards. Such being the case, the question of supply of ammunition assumes even greater proportions. The weights of the Hotchkiss and Hebler cartridges are in the ratio $\frac{521}{640} = .81$, and it must be remembered that this ratio is still less with other rifles of .45 caliber, 500 grains being the usual weight of bullet for that caliber. Machine-guns must carry at least 10,000 rounds of ammunition, and the saving in weight is very considerable.

The following is an abstract from an article by Lieutenant Beehler, U. S. Navy, entitled "Recent Progress in Small Arms":

"Experiments on animals demonstrated that the wound caused by the Hebler bullet was much less serious than that from others. The Hebler bullet makes a clean hole, while others make ragged and splintered holes, so that even if vital parts are not struck, the wound made remains serious for years. In one case a man shot by Hebler bullet in upper left arm entirely recovered in three months though he was *hors de combat* for two months."

Nearly all foreign powers have made extensive experiments and some have already adopted small arms of reduced caliber. Portugal has the Guéde, cal. .323, and a bullet weighing 264 grains; the proposed rifle for Italy is the Freddi (recoil), cal. .315, weight of bullet 225 grains; Sweden, the Jarmann, cal. .397, bullet, 337 grains, but only 1000 of these arms have been issued, as many demand a further decrease of caliber. In France it appears that the introduction of the Gras-Lobell (?) rifle, cal. .315, was advocated, and the manufacture of this arm was to have begun at the Tulle factory, but owing to the uncertain state of Europe it was deemed inadvisable to commence the re-armament of the infantry, which would take about three years. The largest caliber at present in use abroad is the .433, and all the countries using this are on the verge of reduction of caliber. The latest order for rifles of reduced caliber has come from Austria. This order is for a number of Maxim automatic machine-guns, caliber 7 mm. = .28 in.

FIG. 1



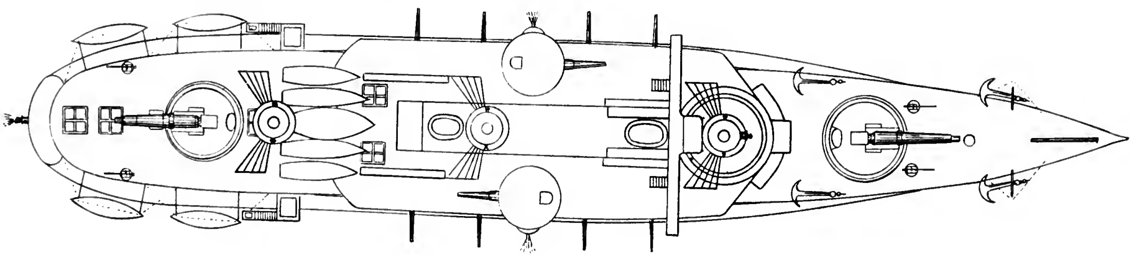


FIG. 2

PROFESSIONAL NOTES.

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A PROPOSED NON-SINKABLE BATTLE-SHIP WITH A CONSTANT WATER-LINE.

Translated by LIEUT. ALBERT GLEAVES, U. S. N.

[Mittheilungen aus dem Gebiete des Seewesens, Vol. XVI., Nos. III. and IV.]

In 1886 the French ships Thetis and Reine Blanche collided off Hyères Roads, and the latter would have been a total loss had it not been for the coolness and the skillful seamanship of her captain, the present Rear-Admiral Pallu de la Barrière.

In the August of that year, Captain Barrière had published in the *Revue des deux Mondes* a paper upon the theory of saving ships from sinking under such circumstances, and this experience gave him the opportunity of seeking further the practical means by which this could be accomplished.

The solution of the problem Barrière thought he had found in the discovery of the properties of the fibres that envelop the fruit of the cocoa-palm, and which are generally known as amorphous cellulose. His idea—and it did not seem altogether unreasonable—was to construct a powerful armed and protected ship that would compare favorably with the heaviest armored ship completed or on the stocks, whose vitals would be invulnerable to ram and torpedo, and whose speed would surpass that of the large ironclads, notwithstanding its much smaller displacement.

The present plan of Admiral Barrière should, according to the *Yacht*, from which these notes are excerpted, satisfy all these conditions. It was perfected by the competent engineers of the Ateliers et Chantiers de la Loire, the accuracy of whose calculations can be relied upon.

The principal dimensions of the ship (see Figs. 1 and 2) are :

Length between perpendiculars, 120.51 m.; greatest breadth of beam, 19.5 m.; depth from main deck beams to water-line, 9.85 m.; mean draft of equipped ship, 7 m.; displacement of equipped ship, 9767 tons.

The calculated speed for the maximum draft of 7 m. is 19 knots, and a coal capacity is guaranteed for 4500 sea miles at 10 knots.

The conditions that this plan should fulfill are as follows :

I. Non-sinkability, and steadiness of gun platform, or, in other words, absolute buoyancy.

II. Complete protection from hostile shot of the vitals of the ship, such as the engine and boiler rooms, the magazine, and the steering gear.

III. Complete protection of the heavy guns and the conning tower, which contains the appliances for steering the ship and directing the battery.

IV. Sufficient protection of the light guns and the upper works from the destructive effect of shell with large bursting charges.

V. The most effective means of attack and defense, and great speed with a proportionally small displacement.

We shall now discuss generally the means by which the above conditions may be realized.

I. Absolute buoyancy. The manœuvring power and speed of the ship should be maintained, and the use of the ram and gun guaranteed, under all circumstances. The division of the hull into water-tight compartments cannot alone answer these requirements, for the filling of one or more of these compartments would not only change the trim and consequently diminish the speed and lessen the advantages of the ram, but would also cause the ship to heel, thus rendering the use of the guns difficult if not impossible. Armor fulfills its object only when it is of proper thickness and extent, but it is always limited by the dimensions of the ship.

In regard to modern battle-ships, the question is not alone one of penetration of shot, but it is also necessary to consider suitable means for protecting the crew from the terrible effects of ramming, or the explosion of torpedoes, and the devastation caused by a melinite shell. That, however, which is most important in a battle-ship is a "floating belt," in the real sense of the words, that is, a belt which, acting automatically, when penetrated, will stop a leak and arrest the inflow of water, thereby preserving the buoyancy of the ship and keeping it on an even keel.

The material for the belt of the proposed ship is cellulose, which, as has been already stated, is a stuff obtained from the fruit of the cocoa-palm, and has the color and form of ground coffee. Its characteristics are lightness, great elasticity, expansion, and resistance to friction and decay. It is also proof against destruction by insects, which cannot live in it. It must, however, be kept from direct contact with steel, and this is effected by a light coat of paint on the bulkheads. Its most important quality is its elasticity; that is, it will immediately close up in the wake of shot passing through it; and it is claimed that a ship provided with a girdle of cellulose may be riddled with shot and yet remain afloat with unaltered trim. The patent consists in a process of extracting the glucose. Its opponents declare that the glucose is not entirely extracted, and that the cellulose is liable to decay, and that it gives off odors which would be a strong objection against its use in ships. It is one of the lightest substances known, its sp. gr. being only 0.8. It has been applied in the Haytien and French navies, and the English shipbuilders have used it in a few vessels, although it is a question whether it is really serviceable. The term "coffer-dam" has been applied to the material because it serves to keep water out of the breach caused by the projectile.

The proposed belt which is to maintain the ship buoyant is arranged in three parts as shown in Fig. 3, which are separated by steel bulkheads. The outer part is filled with loose cellulose mixed with cellulose in different degrees of compression. At the midship section it has a thickness of one meter, and reaches 0.6 meter above the water-line, gradually rising as it approaches the ends of the ship until it attains a height of 2 meters above the water-line at the bow and 1.8 meters at the stern. It extends to 4 meters below the water-line throughout the length of the ship. As shown in Fig. 3, the belt is intersected by the protecting deck, and it is further divided by transverse steel bulkheads into water-tight compartments. The volume of these compartments in the centre of the ship is about 3.6 m^3. It is known by experiment that the passage of a 42-cm. shot through this part of the belt (the outer part) will make a hole whose volume is 0.3 m^3, or about one twelfth the volume of the compartment, and the thickness of the cellulose is diminished by compression from .12 to .11 of its original thickness. This proportion gives the amount of elasticity to be expected from the cellulose.

The other parts of the belt are divided by steel bulkheads five or six meters apart, and are entirely filled with bricks of cellulose. The middle part is 0.8 meter thick, and the inner one 0.7 meter thick. The three parts of the belt extend the entire length of the ship and have a total thick-

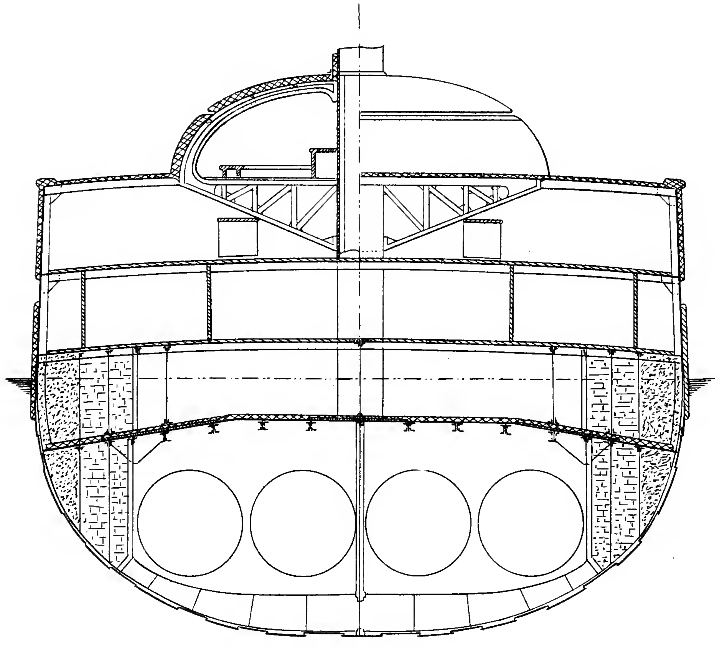


FIG. 3.

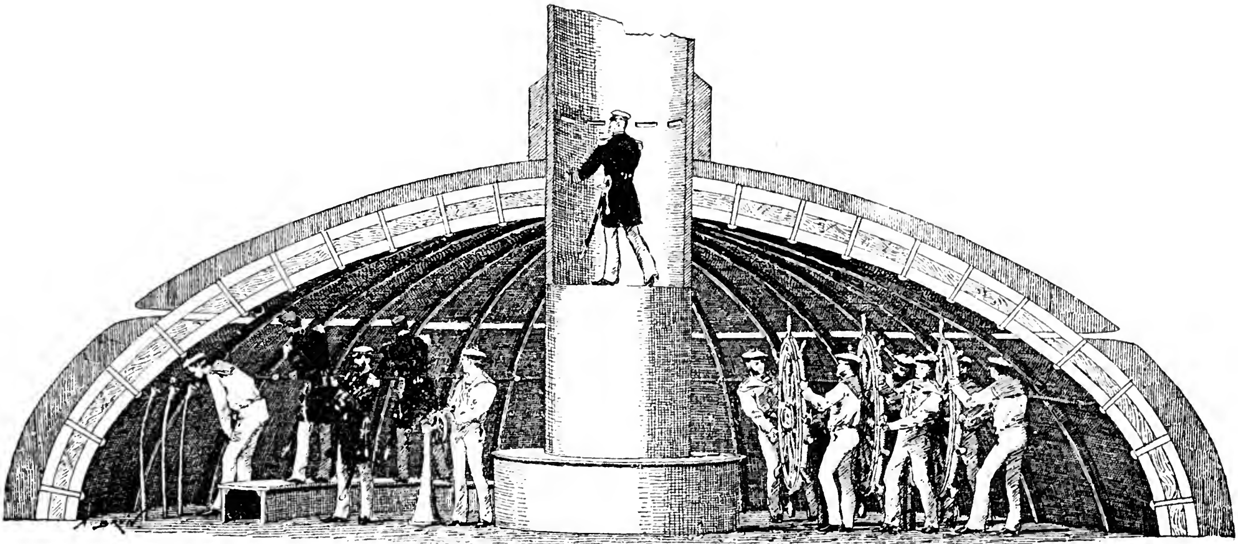


FIG. 4.

ness of 2.5 meters. On the armored deck over the belt is a "rampart walk" from which the condition of the upper part of the belt can be observed.

The splendid results that cellulose as a leak-stopping material gave at the trials at Toulon in 1881–82, when a "coffer-dam" target was fired at with 14-cm. and 27-cm. guns, led to the conclusion that, with sufficient thickness and depth under water, a belt of this material would render a ship innocuous to wounds from either ram or torpedo.

II. Protection of the vital parts of the ship from the effects of artillery. The engines, boilers, magazines, and steering gear are protected by an armored deck that extends over the entire length of the ship. The crown of the deck amidships is 1.2 meters below the water-line and is 10 cm. thick; it dips down to the ship's side 2 m. below the water-line and on the inclined portions is 14 cm. thick. It is of compound steel, and shot can penetrate it only at moderately sharp angles. Therefore, this deck, which until recently was opposed, must be considered one of the most efficient means of defense.

III. Protection of the heavy guns and the conning tower. The ship carries two 42-cm. guns mounted in barbette, and two 27-cm. guns in revolving turrets. The barbettes are placed in the bow and stern; the forward gun has a sweep all around the bow from right ahead to 54° abaft the beam, and the after gun is so placed as to fire around the stern through an arc of 256°. The two 27-cm. guns are mounted in turrets on each side of the ship and have a lateral train of 180°. The barbettes and turrets are armored with 35-cm. plates backed by 20 cm. of teak. The additional twelve 16-cm. guns are installed in a superstructure that is plated with 10-cm. steel plate, and is therefore only protected from melinite shell.

The conning tower is shown in Fig. 4. Its form is that of a cupola with a somewhat elliptical profile; the plating is in two parts, and diminishes in thickness towards the top. The inside diameter of the tower is 10 m. The lower part is 30 cm. at the base and 20 cm. at the top; the upper part is 20 cm. thick at the lower edge, and this reduces to 15 cm. at the crown of the cupola. The two parts are separated by a space 15 mm. wide, which gives the greatest view possible of the horizon, and is at the same time sufficiently protected from shot from rapid-firing guns of small calibres. It is 1.8 m. above the floor of the tower, and a circular platform is provided for convenience when looking through. Twenty-one people are supposed to be stationed in the tower—the captain, executive officer, navigator, torpedo officer, midshipmen, and wheelsmen. The wheel, speaking-tubes, etc., are also placed here. The foremast passes through the tower, and is made strong enough to bear its entire weight. (See Fig. 3.) The mast itself is clad with a 10-cm. plate in which are cut rectangular sight-holes; a narrow door in the mast permits ascent to a platform inside.

IV. Protection of the upper works and the secondary battery against shell with large bursting charges. This protection consists of a compound steel plate which is fastened to the side and extends from 1 m. under the water-line to 3 m. above. Amidships it is 10 cm. thick, and diminishes to 8 cm. about twenty meters from the end of the ship. As already stated, the superstructure is plated with the same material.

A light splinter deck covers the redoubt and protects the gun's crew from shot out of the enemy's tops. It consists of two layers of chrome steel plates 4 mm. thick.

V. Means of attack and defense. Great speed. The armament of the ship, as we have seen, consists of four heavy guns, twelve medium guns, and twelve rapid-firing cannon, of which four are 65 mm. and eight are 47 mm., and also six 37-mm. revolving cannon. Two of the 65-mm. guns are placed forward and two aft; the forward ones fire through an arc of 135°, and the after ones through 200°. The 47-mm. guns are mounted in the tops, two in the main, and three each in the fore and mizzen.

A considerable amount of ammunition is allowed:

75	rounds for	each of	the	42-cm.	guns,
110	"	"	"	27	"
110	"	"	"	16	"
500	"	"	"	R. F. G.	
700	"	"	"	machine	"

The weight of metal that the ship can deliver ahead and astern is 1212 kg., and on the broadside 1776 kg.

Vice-Admiral Bourgeois was of the opinion that the 42-cm. guns should be placed in turrets, and the 27-cm. guns in barbette. Indeed, the great importance of the heavy 42-cm. guns makes it essential that they have the greatest amount of protection when at close quarters, and this can be obtained only by turrets. The Director of the Chantiers de la Loire, who recognized the force of this objection, had also prepared a plan for installing the guns in this way, but found it impracticable owing to the colossal dimensions and great weight of the turret, and the fact that the smallest variation in the revolving mechanism would render the training of the guns impossible. The question was therefore decided in favor of barbette towers.

Of the twelve 16-cm. guns, eight are mounted in broadside; the other four are placed in the angles of the superstructure, and can be trained in line with the keel as well as on the beam.

The proposed ship will have a speed of 19 knots, and will therefore be superior in this respect to almost all other battle-ships completed or in course of construction.

By the great dimensions of the ship, its small displacement, and proportion of length to breadth, which is more than 6, it appears that the least value of M in the formula $V = M\sqrt[3]{\frac{F}{B^2}}$ is 3.8, in which B^2 is the area of the immersed midship section and F the indicated horse-power. Hence, for a speed of 19 knots (B^2 being 123 m^2), I. H. P. is in round numbers 15,000.

The most difficult part of the problem was the selection of the type of engines and boilers sufficiently powerful to realize this, and at the same time of such dimensions as would permit their being placed entirely under the armored deck, which is 1.2 m. below the water-line amidships and 2 m. at the sides. It was finally decided to have two horizontal triple-expansion engines for each screw placed in line. Each engine is in a water-tight compartment, and so arranged that the two engines working the same shaft can be uncoupled and worked singly. This arrangement is considered the most economical, especially with reference to the consumption of coal and lubricants, owing to the great variations of speed that would probably be required of such a vessel.

Steam is supplied by twelve cylindrical boilers. Each boiler has two furnaces with corrugated fire-tubes of the Fox system. On each side of the fire-room are six boilers, arranged in three groups, each boiler in its own water-tight compartment. The two forward groups have the same smoke-stack, and are separated from the after group by an athwartship coal-bunker.

Each of the six fire-rooms contains a ventilator for forcing the draft when the fire-room is closed, and for ventilation when the fire-room is open and the draft normal.

The coal capacity is 650 tons, which is sufficient for 4500 miles at 10 knots.

We have outlined the plan suggested by Rear-Admiral Pallu de la Barrière of a modern battle-ship of the first class that would be a suitable antagonist of such vessels as the Nile or Trafalgar of 11,900 tons, or the Re Umberto and Sardinia of 13,800 tons. It only remains to speak briefly of the construction of the hull.

From Fig. 3 it is seen that the inner bottom comes against the lower edge of the cellulose belt. The space between the inner and outer bottoms is divided by four longitudinal bulkheads on each side of the keel. A longitudinal water-

tight bulkhead is placed amidships over the keel, and reaches upward to the armored deck. A great number of transverse water-tight bulkheads serve to brace the ship and give it great strength and stiffness.

The ram is of cast steel and supported from the armored deck and by stout bow braces.

The *Yacht* concludes its report with the wish that the plan of Admiral Pallu de la Barrière, which is at present undergoing a rigid investigation by the Minister of Marine, may yield him enduring honor.

From the result of the recent exhaustive trials in France with cellulose, no positive conclusion can be as yet deduced as to the value of the proposed belt, and consequently of the proposed ship. In case, however, the peculiar characteristics claimed for cellulose are established by actual practice, we are not wrong in attributing to it a very important and significant value.

As the armored deck is considerably below the water-line and combined with the belt, by its thickness and the great strength given to it by the transverse bulkheads and division walls of steel, it will oppose a very strong resistance to the ram, and will prevent the penetration and destruction of the belt. Trials with the Belliqueuse at Toulon and the Resolute at Portsmouth show that the belt is also proof against torpedoes.

The decision of the French Minister of Marine, which will probably soon be made public, will be waited with great interest. Indeed, it may help to the final solution of the vexed question, "What is the best type of battle-ships?"

DEEP-SEA SOUNDING MACHINE.

A neat improvement in deep-sea sounding machines is figured in the U. S. Fish Commission Report for 1887. It was designed by Passed-Assistant Engineer Baird of the Navy, the chief engineer of the Albatross.

Unlike other sounding machines, the reel and the pulley are separate, the former being of ten per cent aluminum bronze, and the latter of cast-iron.

The original reels used on board the Albatross—in the Sigsbee sounding machine—were built up of steel; the groove for carrying the driving belt was bolted to the reel, and its weight added to that of the reel, which was not desirable. It is essential to have as little weight as possible in the moving part of a sounding machine.

The Sigsbee sounding machine was driven by a little half-trunk engine, designed by a Mr. Bacon of New York, which was not satisfactory, to begin with; in taking a sounding, the belt had to be taken off to detach the reel from the engine. When the sinker reached the bottom, the wire would kink and break—losing the sounding-rod and thermometer—if the ship were pitching any; so it became necessary to ship quickly the cranks, and wind in a few fathoms by hand, sufficient to bring the outfit clear of the bottom of the sea. The belt was then shipped and the engine started. At this point of the proceeding a most disagreeable circumstance invariably occurred: the engine—a single cylinder—was full of water; it stopped again and again on the centre; the steam and water blowing from the cylinder raised a cloud about the machine, and several minutes were lost in getting the engine well started. Captain Tanner, who was always anxious to obtain the best possible results, readily approved the design of his chief engineer, which resulted in the neat device figured in plate.

The aluminum bronze reel *A* is cast in one piece, strongly ribbed; its circumference is a fathom, like that of the Sigsbee reels; it is mounted on and is feathered to a steel shaft, *B*, which moves the journals of the Sigsbee machine, *C*, *C'*. On the same shaft there is a cast-iron friction-wheel, *D*, that moves freely on the shaft; the rim of the friction-wheel is scored for the

rope belt. By moving the crank *F*, the friction-wheel is moved in and out of contact. The lever *G* actuates a block-friction, which is used to retard or to stop the reel; it is covered with leather, which presses directly against the wire on the reel. The entire framing of the Sigsbee machine was utilized, and the original reels can be replaced in a few minutes if necessary. Indeed, all parts of that admirable machine, except the reel, seem to be in the highest state of the art.

To operate the new reel, the friction is withdrawn by revolving the crank *F*, and the lever *G* is moved until the block presses against and holds the reel; the sinker, sounding-cup, and thermometer are properly attached to the "stray line" and swung over the side; the friction-lever *G* is slacked and the reel begins to lower away, revolving on its axis. The engine is then leisurely started, and the friction-wheel *D* is revolved in the opposite direction, —*i. e.*, in the direction to *wind in;* there is no hurry about this latter operation, and the water is worked out of the engine without the great cloud of steam. When the sinker reaches the bottom, the hand-crank *F* is turned quickly, the friction-wheel *D* engages the reel and reverses its motion quickly, and the wire at once comes in. From two and a half to five minutes in time are saved at each sounding; the danger of losing the "outfit"—costing about $30—is diminished, and the nuisance of a cloud of steam and of delay are avoided.

This reel, built about eighteen months ago, is probably the first casting of aluminum bronze ever used by the Government. Its great reported strength is what recommended it. The pattern was made in Washington, but the casting was made by the Cowles Company in Cleveland, Ohio. It was shipped to Washington when it was finished. While in the lathe it was found to be very hard on one side and quite soft on the opposite side, which gave Mr. Baird the impression that the metals were not well mixed and that the reel would be weak.

There were 4500 fathoms of No. 11 music-wire (about 0.028 of an inch diameter) wound on the reel before the Albatross started from Norfolk for the Pacific, in November, 1887, and it has been used continuously ever since in all depths; on one occasion the 60-pound sinker did not detach, and was wound in from 2000 fathoms depth at a tension much above 60 pounds. It has been estimated that the compression strain per square inch of section on the barrel of the reel was above three tons. W. F. W.

SUBMARINE ELECTRIC ILLUMINATION.

[From *Rivista Marittima*, April, 1888.]

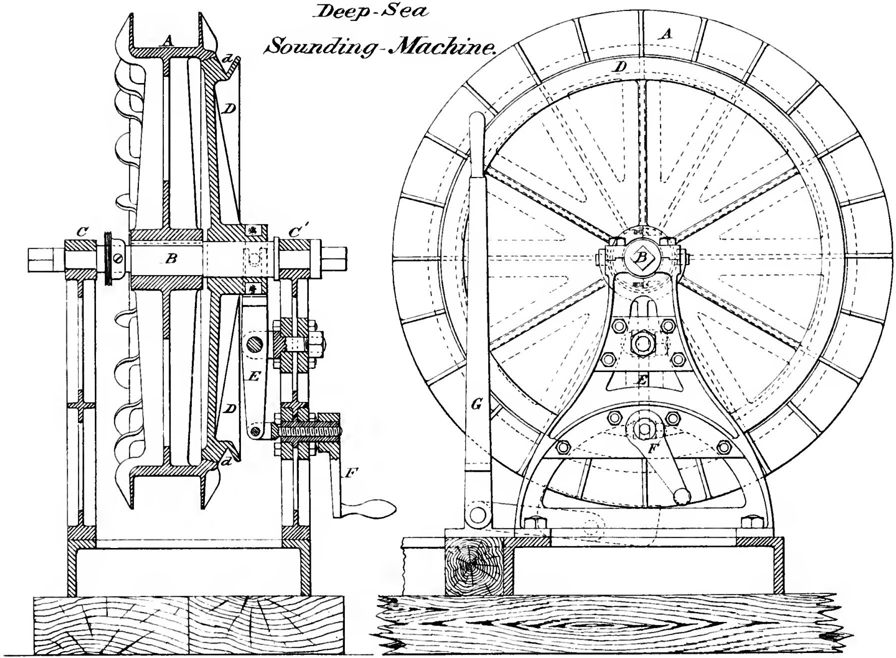
The author, C. Scotti, lieutenant in the Italian navy, briefly describes several methods heretofore in use for subaqueous lighting; among them the system Denayrouze, and that of M. Bazin, which latter was used in determining the damages done to the sunken Alabama in 1864. Then, continuing, the author describes his own plan:

Desiring to furnish the diver with a small and powerful electric lamp, and thus to facilitate many submarine operations, leaving the diver free in his movements, I have devised the following system, which will always fulfill the end in view. . . . . I substitute for the Denayrouze [petroleum] lamp an electric lamp of greater power, and so placed as to illuminate constantly the path of the diver without dazzling him. As far as possible the lamp is to project the light in a conical rather than a cylindrical form, so as to prevent useless loss of rays.

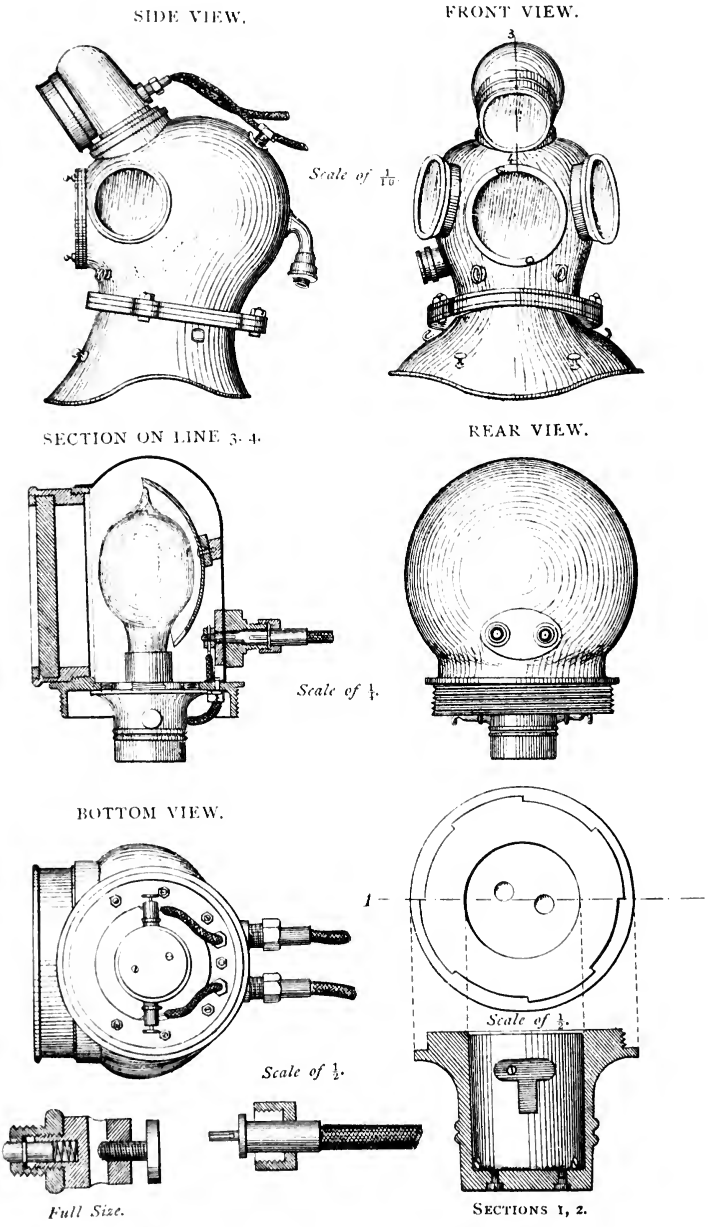
On the upper central opening of the diver's helmet is fixed, in place of the glass, a small helmet-shaped box, within which is an incandescent lamp fixed

Plate V.

Improvement in
Deep-Sea
Sounding-Machine.



ELECTRIC SUBMARINE ILLUMINATION.



on a standard, screwing air-tight to the lower part of the box. The standard is of bronze and surrounds an ebonite cylinder, which in turn contains two half cylinders of bronze, insulated and destined to unite the poles of the lamp in communication wtih the conducting wires. On the back of the box two other stems, insulated in cylinders of ebonite, terminate in the interior in two binding-screws, and on the outside in a sleeve and union connecting the conducting wires.

The lamp that best fulfills the conditions of lighting power with small size is the Bernstein of 100-candle power, 50 volts, and 5 ampères. The rays of light are projected in a cone by the reflector in rear, through the thick glass plate in front.

The electric force to be employed should be such as to produce the necessary current for supplying the lamp—either a battery of accumulators or a dynamo. The dynamo to use should be of 200 carcels, 50 volts, and 13 ampères, and should be set up on a steamer. However, if it is required to carry on work on the bottom of a ship furnished with an incandescent illuminating plant, the lamp can be connected with the conducting wires.

Using a dynamo like that mentioned above, the electricity will be in excess of that required, so that it will be necessary to place some resistance in the circuit, or a second incandescent lamp, which will give light to those working on the boat. The points to be determined in the experiments with the lamp above described were—

1. To show that the lamp worked well, and that the system was well constructed and water-tight.

2. To determine if the diver, after working a certain time, suffered from the heat evolved by the lamp.

3. To determine the working of the lamp under water, and to institute diving work under the bottoms of ships at various depths and under different conditions of sea-bottom.

By day, and at a depth of 9 meters, two divers were sent down successively with the lamp in operation; after about an hour's immersion for each one, there could not be discovered the slightest defect in the system, nor did either of the divers suffer.

Three successive descents were made at night, each lasting about an hour and a half, three different divers being employed—one under the hull of a ship, one on rocky bottom, and the third on muddy bottom.

The results were most successful, the divers declaring that to a depth of 3 meters they could see better than in the daytime; in fact, they were able to find with the utmost ease several objects that had been thrown overboard, and to carry on various kinds of work.

The rays from the lamp penetrated to the surface of the water, resulting in the advantage of being able to note the working of the lamp and to tell the whereabouts of the diver.

The person in charge of the above experiments testified to the good working of the lamp under water, and confirmed the statements of the divers sent down.

The system is therefore well fitted for the work, because it causes the least fatigue to the diver, and enables him to work on the bottom in any position, either by day or by night. Care should be taken not to light the lamp before immersion, since the heating of the glass may easily cause breakage when the diver descends.

The lamp should be lighted just after the diver is under water, and then all danger is avoided, the temperature of the glass and the box being then very moderate.

For ease in manipulating, the two conducting wires should be led together enclosed in a canvas covering fastened to the hose, or, better still, enclosed with the hose in the same canvas covering.

This new system that I have described briefly was of great use in the salvage operations on the Umberto I, of the *Società Generale di Navigazione*, wrecked towards the close of October, 1887, near the island of Ventotene. J. B. B.

GYROSCOPIC TORPEDOES.

By Chief Engineer N. B. Clark, U. S. N.

Two torpedoes are represented in which as much as possible of the machinery is arranged to revolve in order to secure the "directiveness" that accompanies gyroscopic action.

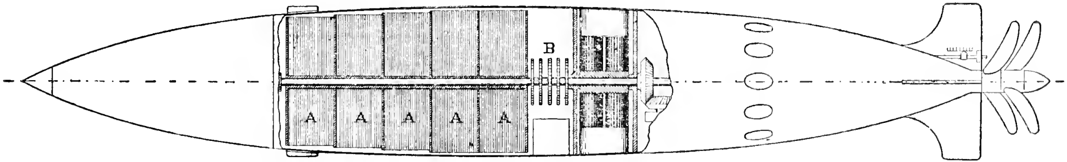
No. 1 is an electric torpedo driven by storage batteries, *AA*, which are keyed on the shaft and revolve with the screws. The batteries are not all coupled at first, but, by the aid of a clock-work, which is started at the launch of the torpedo, metallic brushes are successively depressed upon the collars, *B*, in order to throw on the power of fresh batteries and so maintain or, if desired, accelerate the speed at the close of the run.

No. 2 is a pneumatic torpedo in which the air-reservoir, *C*, is revolved with the screws by the pneumatic engine, *D*, the hollow shaft serving as a conduit for the air. A clock-work, *E*, regulates the admission of the air to the valve chest of the engine by moving a slide across an orifice whose shape and dimensions are such as best to maintain the speed near the close of the run. Direct gearing from the moving parts of the torpedo may be substituted for the clock-work in both torpedoes.

The trajectory of both torpedoes is governed by the cylindrical bellows, *F*, which is open to the sea, the water pressure being counterbalanced by the springs.

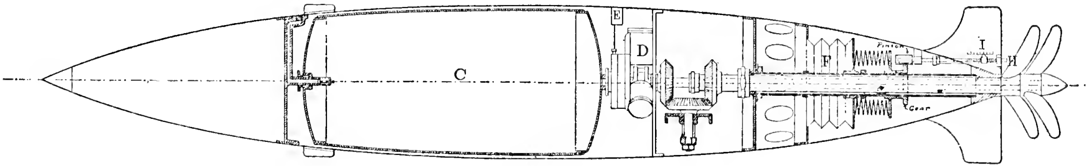
The tension on the springs is adjusted by the spindle, *H*, in obedience to the index and scale of depths, *I*.

When the torpedo dives too deeply, the springs yield to the increased pressure of the sea, and the accumulating weight at the stern throws the head of the torpedo up. When the surface is approached, the reverse action takes place.



No. 1.

1½ ins. = 1 foot.



No. 2.

BOOK NOTICES.

ENGLISH AND AMERICAN RAILROADS COMPARED. By Edward Bates Dorsey, C. E., Member Am. Soc. C. E. and Am. Inst. M. E. John Wiley & Sons, New York, N. Y.

This work is the outcome of papers read by Mr. Dorsey at meetings of the Am. Soc. C. E. in 1885, and for which the author was awarded the Norman gold medal for the year ending August 1, 1886. The Society's edition of the papers and the discussion thereon being exhausted, the author, with the consent of the Society, has published a second edition, with an appendix, containing much new matter, in order to meet the public demand for his work.

The author has treated the subject most exhaustively, and has succeeded in presenting his views in a very clear and attractive manner. In glancing through the book, the array of figures and tables seems very formidable, but the author in his preface kindly refers us to several pages that "contain a few of the most salient facts," and after reading those pages, one finds so much said in favor of our own American roads, both as regards cost of construction and cost of operating expenses, that one is tempted to go deeper and deeper into the subject until even the most formidable array of figures becomes interesting reading.

Mr. Dorsey is a member of the Naval Institute, and his name is familiar to the readers of our Proceedings, through his contribution of the paper on Steel for Heavy Guns, which provoked such an extensive discussion, and which had the result of giving much useful information to the world on that very important subject. C. R. M.

COMPENDIO DE BALISTICA EXTERNA. Part I. By Dr. A. L. Barbosa de Oliveira, Professor at the Naval School, Rio de Janeiro, Brazil. H. Lombaerts & Co., Rio de Janeiro, 1888.

This valuable mathematical treatise on exterior ballistics has been favorably reported upon by a committee appointed to examine the work, and in accordance with its report the work has been adopted as a text-book at the Naval School of Brazil. This is only the first part of the work, and so far as the author has gone, he has treated the subject in a thorough and comprehensive manner. J. L.

THE VOYAGE OF H. I. A. M. SHIP FRUNDSBERG IN THE RED SEA AND THE COAST OF INDIA AND CEYLON DURING THE YEARS 1885–1886. By Jerolim Chevalier von Benko, Commander I. Navy. Supplement to Vol. III. and IV. of 1888, of Mittheilungen aus dem Gebiete des Seewesens.

This volume gives important and detailed information about the places visited, and sailing directions to and from them, with necessary meteorological data. E. H. C. L.

SCHIFFBAU. By A. v. Hüllen. Lipsius and Tischer, Kiel.

This work is very elementary, and only useful as a text-book for practical men who have but little knowledge of mathematics. The practical construction of steel ships is not treated of as thoroughly as it should be in this advanced age of steel shipbuilding. The theoretical part of the work seems to be mathematically defective, and particularly is this so in the demonstrations regarding the rudder. We have no doubt, however, that the book will serve a useful purpose in giving a sort of general knowledge of shipbuilding to those wo do not care to enter deeply into the subject. E. H. C. L.

BIBLIOGRAPHIC NOTES.

AMERICAN CHEMICAL JOURNAL.

VOL. X., NO. 3, MAY, 1888.

T. W. Richards has redetermined the atomic weight of copper by precipitation of silver from silver nitrate, finding the figures 63.436. J. P. Cooke and T. W. Richards correct their previous results on the atomic weight of oxygen, obtaining 15.869. W. O. Atwater notes the sources of error in the soda-lime determination of nitrogen. W. Spring's work on the union of bodies by pressure is reviewed, and also that of C. Winkler on compounds of the metal germanium. C. R. S.

ANNALEN DER HYDROGRAPHIE UND MARITIMEN METEOROLOGIE.

VOL. 5, 1888. The influence of the sun and moon on the magnetism of the earth, the pressure of the air, and the electricity in the air, by Dr. P. Andries. Remarks on the hydrography of the east coast of Africa, south of Zanzibar. Remarks on the harbor of Peterhead, Trinidad. Voyage of the German brig Albert Reimann from Port Natal to Macassar, April 16 to June 22, 1887. Remarks on a passage through Le Maire Strait, and the quieting of waves by means of fish oil. Zodiacal light. Remarks on Panama and Port Townsend. Description of two waterspouts in the Pacific. Approaches to Nusa on Pleasant Island. Deep-sea sounding in the South Atlantic. Determination of geographical positions in the Inland Sea of Japan. Quarterly weather report. Minor notices: Anchorages off Santa Cruz, Teneriffe. The Galapagos Island. Finsch harbor. Anchorage off Macao. Fogs in Germany. Suva on the island of Viti Levu, Fiji group. Hydrographic notices about the east coast of Africa, from Zanzibar to the Bay of Manda. Deep-sea soundings in the North Atlantic. Geographical position of places in the Netherland Indian possessions. Sailing directions for sailing vessels across the Atlantic to and from the east coast of Africa. Report on a hurricane on the 25th and 26th of November, 1886, in the South Atlantic. Meteorological observations in Possiette and Vladivostock on the east coast of Siberia. Short hydrographic notices.

E. H. C. L.

COMPTE RENDU DES TRAVAUX DE LA SOCIÉTÉ DES INGÉNIEURS CIVILS.

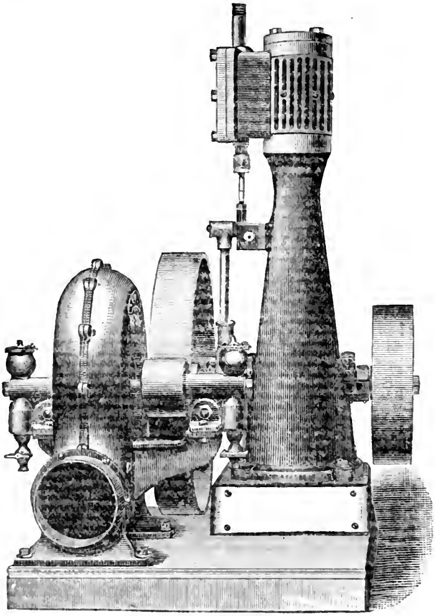
4e SERIE, 41e ANNÉE, 4 CAHIER.

The greater part of this volume is taken up by a plan and discussion thereon of improving the harbor of Havre and the lower part of the Seine. Also a short description of the Latrigue single-rail railroad. E. H. C. L.

ENGINEER, NEW YORK.

JUNE 16. Wheeler's combined engine and fan-blower.

This compact and convenient machine was designed especially for use on steam launches, yachts, and other steam vessels where there is but little room to spare. It is also adapted for stationary or other purposes requiring an independent blowing apparatus. The engraving shows a small vertical steam engine with cylinder 2¾" diameter by 3" stroke, driving by means of friction-pulley a fan-blower having a 5¾-inch discharge nozzle. The engine, when making 500 revolutions per minute, will give 2500 revolutions of the blower, and this with a pressure in steam chest of engine not exceeding twenty pounds, which is very low for the amount of work done. The air pressure is equal to nearly four ounces, and will furnish sufficient air for a boiler having 6 to 8 square feet of grate-surface.



The friction-pulleys are carefully covered with a superior quality of oak-tanned stretched leather, and are kept in perfect contact (without undue pressure) by springs, adjustable with a thumb-screw not shown in the engraving.

Mr. Wheeler found in applying his surface condensers to marine engines which had previously worked non-condensing, the necessity for using forced draught for the boiler to replace the blast previously effected by the exhaust. Experiments with an ordinary blower, connected by countershaft and belting

to the main engine, were not successful, as the belts gave constant trouble by running off the pulleys when the main engine was reversed or started suddenly. There being nothing in the market in the way of a small, compact, independent blowing apparatus, he designed the very effective and inexpensive machine here illustrated. For further particulars apply to Fred'k M. Wheeler, M. E., 93 Liberty Street, New York.

ENGINEERING.

APRIL 6, 1888. Forced draught.

Paper read before the Institution of Naval Architects. Gives results of trials on merchant steamers.

Forced draught in the Navy.

Gives results of trials on six naval vessels.

APRIL 13. The material best suited for propeller blades.

Paper read before the Institution of Naval Architects.

MAY 18. Forced draught. Materials for propeller blades.

H. M. S. Magicienne and Marathon; two protected cruisers of about 3000 tons displacement, with many new features in design and construction.

MAY 25. The "Zephyr" system of boat propulsion.

These launches, built by Yarrow & Co., are propelled by the vapor of some hydrocarbon spirit exploded in the cylinders of the engines. The spirit vapor is generated by burning kerosene. A launch 30 feet long by 6 feet beam, with all machinery, weighs only one ton; that is, about one half the weight of a steam launch of equal size. There is no smut, smoke, soot, nor cinders. The whole machinery is automatic, so that the person in charge can give his undivided attention to steering. The boat runs 7 or 8 miles per hour on 1½ gallons kerosene per hour. The consumption of the hydrocarbon spirit is only that due to leakage.

W. F. W.

JOURNAL OF THE ASSOCIATION OF ENGINEERING SOCIETIES.

VOLUME VII., No. 5, MAY, 1888. On a method of making the wave length of sodium light the actual and practical standard of length, by Profs. Michelson and Morley. Present aspect of the problem of American inter-oceanic ship transfer. Minutes of Executive Board of the Council of Engineering Societies of National Public Works.

No. 6, JUNE. Eulogy upon Charles Latimer, C. E., of Cleveland, who was a graduate of the Naval Academy of the class of '41. Index to current literature.

H. S. K.

JOURNAL DU MATELOT.

APRIL 21, 1888. An explorer at Timbuctoo.

MAY 12. Miscellaneous. Centenary of La Pérouse.

JUNE 9. Report of the Consultative Committee on Ocean Fisheries to the Minister of Marine and Colonies.

J. L.

JOURNAL OF THE MILITARY SERVICE INSTITUTION.

VOLUME IX., NO. 34, JUNE, 1888.

The leading paper is an essay on the "Armament of the Outside Line of Defense," by Lieutenant E. M. Weaver, U. S. Army. The argument is that the greatest thickness of steel plates that will have to be destroyed by our shore guns is twenty inches, which will be capable of resisting 1500 foot-tons of projectile energy per ton of plate, and that guns larger than 18-inch caliber will not be floated against the defenses of our seacoast. These conditions of offense, which allow for the further development of best guns and armor, being assumed, the author proposes to arm the outside line of defense with high-power guns of 20-inch caliber. Such a gun would weigh 200 tons, fire a projectile of 4500 pounds, which, at a range of nearly six miles, would have a velocity of 1333 feet, and sufficient energy to penetrate a 20-inch steel plate. "The larger the gun that can be mounted up to a certain limit, the cheaper it will be to defend the coast, for the *effective area* guarded by guns varies with the square of the *effective range* of guns; the cost of making and mounting guns does not begin to increase in the same ratio, and, moreover, the larger *effective area* means *fewer* men and *fewer* forts." In the discussion of the paper by a number of prominent army and navy officers, due credit was given the author for the comprehensive view taken of the subject, the information concerning the action of shot of different forms on plates of different material, and the numerous interesting notes on the latest foreign guns; but his conclusion that so large a gun as 20-inch is needed was generally condemned.

Dr. Pitcher, U. S. Army, contributes a paper on the transportation of the wounded; and Captain R. S. Collum, U. S. Marines, a brief historical sketch of the "Antiquity of the Marines," from which we learn that "infantry as part of the complement of vessels of war was common to the Phoenicians and to all maritime states of Greece at least five centuries before the commencement of the Christian era." A. G.

MITTHEILUNGEN AUS DEM GEBIETE DES SEEWESENS.

VOLUME XVI., NOS. 3 AND 4. The use of carrier pigeons on board of men-of-war.

Carrier pigeons have frequently been taken on board of sea-going vessels and liberated at sea. Those of good breed and good training have generally reached their home-cots on land, provided the weather was favorable and the distance not too great. The reverse is now being tried, namely, to establish permanently pigeon-houses on board of outgoing vessels, and leave the pigeons belonging to these cots on shore, and send them whenever needed with dispatches to overtake their respective vessels. With this object in view, a carrier-pigeon station has been established on board the artillery practice ship St. Louis at Toulon. It consists of a square cage about 5 feet broad and 6½ feet high, placed on the bridge at a distance of about 20 feet forward of the mizzen mast. It is supported on both sides and thus protected from the wind. The pigeons can enter the house freely, but cannot leave it without the help of their keeper. The cage is painted outside in bright red and green colors in order to be seen by the pigeons at a long distance. It is divided into two stories, each having three boxes, so as to carry six pairs.

In order to accustom the pigeons to the report of guns, the cot has been placed near two 19-c. and two 24-c. guns, which fire an average of six hundred rounds a week.

The artillery practice ship will receive on her next cruise a dozen carrier pigeons belonging to the "Société Forteresse," and will in return leave an equal number on shore. After the arrival of the vessel in the roads of Hyères, or during the passage, the pigeons, which have been previously trained on

shore, will be liberated from the vessel, and the ship pigeons will be set free at the same time by the "Société Forteresse."—*Armee Blatt.*

The new navy of Mexico.

The two dispatch boats Democrata and Mexico, and the two gunboats Libertad and Independencia, of the present Mexican navy, will be rebuilt. The appropriation for the purchase of a training-ship has just been granted by the Mexican Parliament. Two transports, one intended for service in the Gulf of Mexico and the other for the Pacific Coast, and five first-class torpedo boats, constitute the nucleus of the new Mexican navy.

Powder works in China.

The Government of China is constructing at the arsenal of Tientsin some powder mills where the brown powder used for breech-loading guns will be manufactured. The mills are being established on a large scale in every respect. The newest and best machines are to be used, and when completed, China will possess the largest and best equipped powder mills in the world.

H. M.

NORSK TIDSSKRIFT FOR SOVAESEN.

SEVENTH ANNUAL SERIES, VOL. 7. Effect of oil on sea waves. The Italian Navy. Calculation of line of position, Mr. A. C. Johnson's method. Cruises of Norwegian naval vessels in 1887. Minor notices: The Italian torpedo boat Fatum. The new explosive, emmensite. Bursting of English guns. Manufacture of war material for foreign powers. New lifeboats. Premium for the best design for an armorclad for the American Navy. The English armorclad Nile. Literary review of Captain Jakobsen's voyage on the west coast of North America, 1881–1883. Official communications.

E. H. C. L.

PROCEEDINGS OF THE INSTITUTION OF MECHANICAL ENGINEERS, LONDON.

SERIES OF 1888, NO. 1, FEBRUARY. The position and prospects of electricity as applied to engineering.

A paper by Mr. Geipel, presenting a summary of the present status of electrical engineering, under the following heads: I. Electric transmission and distribution of power. II. Electric locomotion. III. Electric lighting. IV. Electric metallurgy. A very full discussion by prominent electrical engineers is a valuable addition to this most interesting paper. H. S. K.

REVISTA MARITIMA BRAZILEIRA.

JANUARY to MARCH, 1888. The Rio Apa in a storm; cyclones. Casualties on board ship; a guide to the first treatment to be given in absence of a surgeon. Modern guns. English ordnance. The great war of 1887 (translated from the German review, *Beiheft Mariner-ordnungsblatt*). Foreign navies: Germany; Princess Wilhelm and Ariadne. China; Admiral Lang's squadron. United States; Coast defenses. France; Experiments to determine the efficacy of oil in calming the waves. England; Trials of the submarine torpedo boat Nordenfelt; torpedo-hunters; the squadron of the Medway; the manœuvres of 1888; trials of the Longridge

gun; construction of gunboats of the Buzzard type; dismantling the Minotaur; failure of the torpedo cruiser of the Archer type; bursting of a breech-loading gun of 25 cm.; Henwood method of preserving iron and steel bottoms in ships. Italy; Trials of the plates of the Morosini and Ruggiero di Lauria. Argentine Republic; Creation of a high naval commission. Russia; Launch of two gunboats; increase of the Russian fleet. J. L.

REVUE DU CERCLE MILITAIRE.

April 8, 1888. Methods of instruction in infantry firing (ended). Recent photographic works; astronomic photography. The Verona manœuvres of 1887 (with sketches). Foreign military notes. Miscellaneous. Military papers of Lieutenant-General the Marquis de Vibroye (ended). Fontenoy and Hastenbeck.

April 15. Fitness of blood horses for cavalry duty. Recruiting in the German army. The archipelago of Philippines and Mindanao (plates).

April 22. Future prospects of young men after graduating at preparatory military schools. Mobilization of the Italian army. Railroad stations' commanders. A visit to Gibraltar and Tangier.

April 29. Training of the war-horse, and qualities required in a cavalry officer of the present time (extract of a communication read before the staff of the 1st division of cavalry of the Russian Imperial Guard). Experiments with the compressed air gun in U. S. and Germany. The Michaud telemetric telescope (with cuts).

May 6. Training of the war-horse, etc. (concluded). The Michaud telemetric telescope (concluded).

May 13. Effects of shell torpedoes upon fortifications. Concrete facings and cupolas.

June 10. Comments of the foreign military press upon infantry armament in France, Germany, Austria, Belgium, and Switzerland. The summer manœuvres of the Russian troops in 1888. J. L.

RIVISTA MARITTIMA.

April, 1888. Submarine electric illumination (with plates). The English navy (Admiralty programme presented to Parliament, with estimates for 1888–89). On the corrosion and incrustation of hulls (iron and steel), and the means of preserving them. Transportation of frozen meat on shipboard. Plans for war-ships in the United States.

May. On sea-sickness, by Dr. Antonio Giacich. Combustion with forced draught in marine boilers (translation from *Engineering*). The lighting of the Suez Canal. Experiments with shells charged with dynamite (description of the Graydon system). J. B. B.

REVUE MARITIME ET COLONIALE.

April, 1888. The army budget, and the question of the seaport defenses in England. Historical notes on the French Navy (continued). The oyster beds on the coast of Morbihan (France). Travels in Borneo. Article on the use of cast-iron, steel-bound rifled mortars of 30 cm. for coast defenses. English Navy appropriations (1888–9). Foreign Chronicle—German Navy: Despatch boat Schwalbe. English Navy: Mobilization of the fleet. Sanitary situation of the fleet in 1886. Artillery—Steel wire-wound gun. The pneumatic gun, from the report of the American committee on technics. Canals—Project of a canal around Niagara Falls. Colonies—Defense of the English colonies. Geography—The Scilly islands as a naval station. Engines—A 4000-ton press. Life Saving—A new lifeboat. Telephone at sea. Destruction of torpedoes at Malta. Torpedo experiments against the Résistance. Torpedo Boats: Submarine torpedo boats of Turkey. Cruises of torpedo boats.

May. Collisions at sea (1st part). Double ocean tracks and phonic signals in foggy weather (with diagrams and full descriptions). Historical account of the French navy establishment (concluded). A trip to Borneo. The German merchant navy. Law concerning the repatriation of "stranded" sailors by German vessels. The La Pérouse centenary. The cruisers Irene and Princess Wilhelm of the German navy. The launching of the Nilus and Pheasant. Trials of the Impérieuse, Narcissus, and Fearless. The auxiliary cruisers Oceana, Arcadia, City of New York, and City of Paris. New gunboats. Preparations for the approaching naval manœuvres. Cadets' watch in the engine-room. New process in the manufacture of steel guns. Experiments with nitro-gelatine. Trials of the guns of the ironclad Rodney. Substitution of very volatile liquids for water. Results of proposals for plans for an armored vessel. Tenders for the construction of three Spanish cruisers. A new expedition to the North Pole.

June. Collisions at sea (continued). The minimum compass assignable to phonic signals. Submarine signals (with diagrams). This subject acquires new interest in view of the approaching international conference in Washington. Elements of international maritime law (with a preamble). German merchant navy. Law concerning the repatriation of "stranded" sailors by German merchant vessels (concluded). Laws of astral distances. General report on the sardine fishery by the chairman of the Committee on Ocean Fisheries. Foreign chronicle: English Navy—The cruiser Brisk. The sloop Nymph. U. S. Navy—New regulations for the Naval Academy. Launching of the Yorktown and Vesuvius. The protected cruiser Maine. Artillery experiments on the Orlando. A 150-ton gun. An English gun with a 12-mile range. Naval constructions—New type of English gunboat. Compressed-air subma-

rine boats. New English stations in the Pacific. An unknown reef in the Red Sea. Naval tactics—The game of blockade. Forts against vessels. Torpedoes before the Royal United Service Institution. J. L.

ROYAL UNITED SERVICE INSTITUTION.

VOLUME XXXII., No. 143. Quick-firing guns in the field, by Thorsten Nordenfelt, Esq.

A paper on the pneumatic dynamite gun, with discussion by members of the Institution.

Speed as a factor in naval warfare.

A paper of interest, proving, under varying conditions, the advantages of speed in naval combats. Tables showing the sacrifices that have been made to attain the requisite speed.

PROCEEDINGS OF THE ROYAL ARTILLERY INSTITUTION.

VOLUME XVI., No. 4. A dictionary of explosives (continued); useful for reference. The Maxim automatic machine-gun (continued); description of gun, with results of several trials. An article on the use and great advantages of the Scott's telescopic sights: elimination of personal errors, errors due to difference in level of wheels, etc.

No. 5. A proposed sighting and firing arrangement for turret guns.

By means of which they may be elevated while in the loading position, and fired by electricity, thereby increasing rapidity of fire and lessening exposure of ports.

Atmospheric refraction on target-ranges.

Experiments on this subject. Sighting theodolite at point a known distance off, and noting at different atmospheric temperatures and pressures the apparent lateral and vertical displacement.

UNITED SERVICE GAZETTE.

MAY 12, 1888. Description of gunboat Partridge, recently launched at Devonport.

MAY 19. The Quick Ordnance and Ammunition Co. acquiring patents for improvements in breech-mechanism of heavy guns, entirely new system. A water-proof powder, low maximum pressure, may possibly be used for propulsion of dynamite shells.

JUNE 2. Naval volunteers. Views of Admiral Hornby on defense of merchant ships in case of war. M. K. E.

LE YACHT.

APRIL 14, 1888. Military port defenses. Petroleum engine and boiler. On p. 22, commencement of an article on fighting ships. Practical instruction for officers of the merchant navy. The steam packet City of New York.

APRIL 21. A study on fighting ships (continued). Training of sea carrier-pigeons on board the Couronne and the Saint Louis.

APRIL 28. A study on fighting ships (ended). A race from Southampton to Madeira between the Bridesmaid and Atlantis. Log-book of the Bridesmaid.

MAY 5. The race between the Bridesmaid and Atlantis from Southampton to Madeira. Log-book of the Atlantis.
Rome and Berlin.

An essay after the style of its prototype, the celebrated Battle of Dorking.

MAY 12. Shipbuilding by Government and private industry (Lisbonne). The Yarrow torpedo picket-boat (N. L. C.). Launch of the 1st class French cruiser Cécille. Nautical news and facts: Flags, national and mercantile.

MAY 19. Shipbuilding by Government and private industry (continued). Foreign chronicle: The launch of the dispatch boat Nymph, and gunboat Partridge. Keel and centerboard, experience of Mr. Burgess (L. More). The cork belt, Catu's system. Nautical news and facts: Stability of the Mayflower (Bédart). Log-book of the yacht Sereda (see preceding number).

MAY 26. The armament question in England and in France (G. Weyl). Correspondence on the subject of dockyards and private industry. Marine paintings in the Salon (see preceding numbers). Review of the merchant navy. Log-book of the N. Y. Sereda (concluded).

JUNE 2. Our cruisers, with regard to an article by Sir Ch. Dilke (Weyl). Yacht clubs. The torpedo cruiser L'Epervier. Yachting in England. Application of the new gauge. Remarks on screw propellers.

JUNE 9. The maritime situation in the Mediterranean (Weyl). The spinnaker and its origin (L. More). Barbette cruisers in course of construction. J. L.

REVIEWERS AND TRANSLATORS.

Lieut. E. H. C. LEUTZE,	Ensign H. S. KNAPP,
Lieut. J. B. BRIGGS,	Prof. JULES LEROUX,
Ensign M. K. EYRE,	Prof. H. MARION,
Lieut. A. GLEAVES,	Prof. C. R. SANGER,

P. A. Engr. W. F. WORTHINGTON.

SPECIAL NOTICE.

NAVAL INSTITUTE PRIZE ESSAY, 1889.

A prize of one hundred dollars and a gold medal is offered by the Naval Institute for the best Essay presented, subject to the following rules:

1. Competition for the Prize is open to all members, Regular, Life, Honorary, and Associate, and to all persons entitled to become members, provided such membership be completed before the submission of the Essay. Members whose dues are two years in arrears are not eligible to compete for the Prize until their dues are paid.

2. Each competitor must send his essay in a sealed envelope to the Secretary and Treasurer on or before January 1, 1889. The name of the writer must not be given in this envelope, but instead thereof a motto. Accompanying the essay a separate sealed envelope will be sent to the Secretary and Treasurer, with the motto on the outside and writer's name and motto inside. This envelope is not to be opened until after the decision of the Judges.

3. The Judges shall be three gentlemen of eminent professional attainments (to be selected by the Board of Control), who will be requested to designate the essay worthy of the Prize, and, also, those deserving honorable mention, in the order of their merit.

4. The successful essay shall be published in the Proceedings of the Institute; and the essays of other competitors, receiving honorable mention, may be published also, at the discretion of the Board of Control; and no change shall be made in the text of any competitive essay, published in the Proceedings of the Institute, after it leaves the hands of the Judges.

5. Any essay not having received honorable mention, may be published also, at the discretion of the Board of Control, but only with the consent of the author.

6. The subject for the Prize Essay is, *The Naval Defense of the Atlantic and Gulf Coasts of the United States.*

7. The essay is limited to seventy-two (72) printed pages of the Proceedings of the Institute.

8. All essays submitted must be either type-written or copied in a clear and legible hand.

9. The successful competitor will be made a Life Member of the Institute.

10. In the event of the Prize being awarded to the winner of a previous year, a gold clasp, suitably engraved, will be given in lieu of a gold medal.

By direction of Board of Control.

CHARLES R. MILES,
Lieut., U. S. N., Secretary and Treasurer.

ANNAPOLIS, MD., *March* 1, 1888.

Vol. XIV., No. 4. 1888. Whole No. 47.

PROCEEDINGS

OF THE

UNITED STATES

NAVAL INSTITUTE.

VOLUME XIV.

EDITED BY
J. B. Briggs, Richard Wainwright,
W. F. Worthington.

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NAPOLIS, MD.

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The writers only are responsible for the contents of their respective articles.

CONTENTS.

THE PROCEEDINGS

OF THE

UNITED STATES NAVAL INSTITUTE.

Vol. XIV., No. 4. 1888. Whole No. 47.

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ADDRESS OF CAPTAIN A. T. MAHAN, U. S. NAVY,

President of the U. S. Naval War College,

AT THE OPENING OF THE FOURTH ANNUAL SESSION OF THE COLLEGE, AUGUST 6, 1888.

Ladies and Gentlemen:—It has been the custom, during the few years in which the Naval War College has been in existence, to begin each session by an opening address, intended mainly to explain the objects and methods of the institution, concerning which there has been and still continues a certain amount of misapprehension. In the natural course of things, this custom must at last come to an end with the reason that has occasioned it; but it is perhaps too much to assume that the necessity has as yet altogether passed away for a few words of explanation, partaking partly of the character of defense, by showing the necessity for this undertaking, and partly of the character of limitations, defining what is not, as well as what is, proposed.

Before entering upon this duty of explanation, mention may properly be made of the growing favor of the College in the mind of the Navy at large, as testified by the words and actions of many officers, as well as of certain difficulties and discouragements through which it, in common with most human enterprises, has had to pass—is still passing. Last year, as is generally known, Congress refused

to make any appropriation for it, and the work has been pursued during the last twelvemonth and more under the apprehension that similar action would be taken in the present session, and so compel the abandonment of the work. This fear has happily been removed; and that it has, is chiefly to be ascribed to the change of sentiment in the Navy itself as the objects of the College have come to be really understood; as the officers who have attended the course have gone back to their duties and to their brother officers with a report that has compelled approval, and changed an attitude of doubt, or even opposition, into one of conviction and support. Such professional opinion cannot but be felt, however insensible the method of its action. It will be an evil day for the country when it ceases to have weight; for such impotence could proceed only from degeneracy of officers themselves, or from an unwillingness on the part of the outside public to listen to those most competent to appreciate the wants of the Navy; both contingencies fatal to the efficiency of the service.

Besides the doubt as to the action of Congress, involving the whole question as to whether our really arduous work would be wholly thrown away, there have been other drawbacks and disappointments which, as they affect the course, must be mentioned. The explanation is due to those who attend it, that they may understand why they receive less than might justly be expected; and it is due to the College that it should not suffer in reputation from such disappointment, by a failure to appreciate the obstacles which have been met, and which could neither be avoided nor wholly overcome. Chief among these has been the difficulty in finding officers at once willing and free to devote their abilities to the service of the College and to the development of the course which has to be built up. Few realize, until they are forced to do so, to what an extent the brains and energies of the service are mortgaged in advance by the numerous activities and specialties that have developed of late years. In consequence of these, it has been found that not only are officers otherwise desirable already employed on other shore duty, but those actually at sea, and who may be expected to return in one, two or three years, have engaged themselves for duty at other stations. Doubtless the War College will by degrees gather to itself the small body of instructors which will be needed, and who will readily seek a duty that I venture to predict will be found both interesting and pleasant, as well as most valuable professionally; but as yet it has

not had time to do so, the search of its president has been met with a general result of "already engaged," and dependence has had to be upon the voluntary assistance of officers on other duty who have consented to aid the College by treating one and another of the topics that fall within its scope. I cannot too heartily thank those who have thus, at much trouble to themselves, undertaken work which could bring no reward beyond the satisfaction which good work always carries in itself, and the appreciation of their small audience here. The assistance thus given has been invaluable, and the results most important; but it is easy to see that when other duties have the first claim upon the attention of the individual, it will not be possible to realize as much as when the College course has no rival, and that he will often find himself prevented from accomplishing even as much as he expected. Several instances of such involuntary and unblamable shortcoming have occurred within the past year; and to these was added a misfortune, which at the time of its happening was wholly unexpected, in the sudden detachment of Lieut. Bliss of the Army. This accomplished officer, who to very considerable acquirements added a facility for teaching and a lucidity in explanation, which, combined with untiring readiness to undertake any amount of labor, made him an admirable lecturer on Military Science, had not been quite three years at the College. I was therefore confident, despite occasional misgivings, that he would remain through the next term; and his detachment, wholly without warning, was a painful surprise. The uncertainty of the future did not permit an application for an officer to take his place in time to lecture during the present session. Finally, it was hoped that this opening address would have been given either by the Admiral of the Navy, or by General Sherman, both of whom were requested to do so; but these distinguished officers, who have extended their cordial approval and sympathy to the College and its objects, did not feel able to undertake the task.

Hindrances and disappointments are, however, only incidents in the infancy and life of any undertaking, and are from the first destined to be overcome if the institution has its origin in a felt necessity, and has been wisely planned. It remains, therefore, to show that the War College has sprung from and represents a real want of the service and the country, and that the general lines upon which it has so far been conducted are such as promise to fulfill the actual want, without duplicating work adequately provided for elsewhere in the

Navy. In making this explanation I shall be traversing ground very familiar to myself, and shall have to use arguments threadbare, to me, from frequent use. To some extent they have appeared in print; but while, on the one hand, I cannot hope that they have attracted the attention of all this audience, so, on the other, the opportunity cannot be foregone of bringing them before you, now that by coming here you have put yourselves at the mercy of the speaker.

It will probably clear away embarrassing misapprehensions to state first, to some extent, what the College does *not* propose to do. The term "post-graduate," which has been frequently and not unnaturally applied, which was indeed used by the original board that recommended the establishment of the College, has been unfortunate; suggesting as it does the continuance here, on a higher and broader scale, of the studies pursued by the graduates of Annapolis while cadets at the Academy. If the course here is really post-graduate, it must be in direct sequence of the course at the only institution from which all naval officers are graduated; and the inference naturally follows that the professors and instructors there, who have so long and ably directed the student before graduation, are best fitted to continue his guidance in the higher developments of which also they are masters. To this undoubtedly was due, and not improperly, a certain amount of opposition that was at one time manifested from the Naval Academy; it was perfectly true that there were both the men and the plant by which could best be furthered a strictly "post-graduate" course, and to carry such elsewhere was to waste Government money, and cast an undeserved slight upon the well-proved teachers of an admirable institution. But if, on the contrary, the line of professional study proposed here was in no strict sense a sequence of any one branch, or any number of branches, followed at Annapolis—if it demanded neither the specialties nor the appliances to be found there—if it were "post"—after—only in the sense of subsequent time, and not of consecutive development—the objection falls to the ground. It will, I think, be granted, when we pass from the negative explanation of what the College is *not*, to the positive statement of what it *is*, that this course is "post-graduate" only in the same sense that the special professional training of a man follows after and presupposes the instruction of the home, of the school and of the college, where youths having widely different futures pursue for a time common studies. In a way the term "post-graduate" has its uses; it is understood, or what is much the same thing, people

think they understand it; it appeals to the mania for increase of teaching that pervades our time, and so attracts support; but it was most unfortunate for the infancy of the War College, when submitted to clear-headed men more concerned for the honor of their own alma-mater than to foster a new and possibly rival institution. "Post-graduate! a further development of the Annapolis course! where can this be better done than at Annapolis?" The cry went through the service; and if the premise were conceded, it was difficult to resist the conclusion.

I pass now to another negative qualification, in making which considerable care is needed, on the part of both speaker and hearers, to avoid misunderstanding. It is important that, in excluding from the purposes of the College any professional interest, there should not be a seeming disposition to undervalue it. It is to be said, then, that the War College does not propose to devote its energies to the question of the material and mechanical development of the Navy, except in a secondary and incidental manner; except, that is, so far as may be necessary for the furtherance of its main objects. These objects by themselves will require all the time for which officers can be spared by the Department from other professional demands. *Methods* of construction designed to increase the speed, strength, manœuvring power, stability, invulnerability of ships; *methods* of gun-building, by which the power and accuracy of the gun is developed, or the strains upon the gun decreased; improvements in engines, by which increase of speed and economy of fuel and space are hoped to be effected; the *details* of advance made in explosives, or in torpedoes,—with none of these are we concerned immediately and chiefly, but only incidentally; and that if for but one reason, which will be recognized as soon as stated, namely, that all these matters are already in the hands of a sufficient number of accomplished officers. They—ships, guns, engines, explosives—are now receiving all the attention that the Government owes them. Let me not, however, be misunderstood; the concern of the College with all these matters is nevertheless very close, but it is with the *results* obtained, not with the *methods* followed. How fast a ship will go and for how long; within what space she will turn and how quickly; what resistance she presents to injuries, and what effect certain injuries will have on her safety, speed, or handiness; in regard to guns and torpedoes, their range, accuracy, the rapidity with which they can be fired and the injury they can produce; with engines, the important considerations of speed and coal

endurance—such are the factors that are needed for the investigations of the College, and you will notice that they denote the accomplished results, they characterize the finished weapons which are put into the hands of the military seaman to go forth to battle, to wage war. If his ship will make a certain speed, she may, for all he cares, be driven by a tallow-candle; if his gun will do so much work, it may, so far as he is concerned, be made of paste-board. The strategic and tactical capabilities in which the labors of the designer and builder have resulted, are those with which the admiral and captain, in their properest sphere, are alone concerned; and the antecedent methods by which those results are reached are of secondary importance to the artist in war. Doubtless this argument may be pushed to extreme by an unbalanced mind; the proverbial difficulty of drawing the line will be felt at times, and the line perhaps drawn too much on one side or the other by this or that person responsible for the direction of the College course; but, speaking broadly, it may be said that the true aim is to promote, not the *creation* of naval material, but the knowledge how to *use* that material to the best advantage in the conduct of war.

A very strong argument for thus withdrawing, and, so to speak, protecting, the study of the art of war from too close contact with that mechanical and material advance upon which its modifications depend, is to be found in the spirit of our age, and the effect of that spirit upon our naval officers. For, is not the study of material phenomena, and the bending of the forces of nature to the service and comfort of man, one of the leading interests of our generation? And is not this tendency reflected in the Navy by the almost exclusive attention paid by administrations and officers to the development of the material of the service? Who, and how many, are studying how best to use that material when war has broken out? If you ask for authorities on guns, on powder, on steel, on questions connected with navigation, on steam, on mathematics, almost any one of us can name them; but who are our authorities on the art of war? Look at the Navy Register; how many are the officers who are working at the art of war? Consult the index of the publications of our Naval Institute; what proportion do articles on waging war bear to those on mechanical or physical progress in naval material? Is there then no reason for separating and *nursing* the study of this art for a while from too close contact with these related subjects? I will venture to say that if questions of development of material be

admitted to an equal share of the College's attention in its early years, it will be but a short time before the art of war will be swamped by them and disappear from the course.

And what wonder then, gentlemen of the Navy, that we find our noble calling undervalued in this day? Have we not ourselves much to blame for it in this exclusive devotion to mechanical matters? Do we not hear, within and without, the scornful cry of disparagement that everything is done by machinery in these days, and that *we* are waxing old and decaying, ready to vanish away? Everything done by machinery! as if the subtlest and most comprehensive mind that ever wrought on this planet could devise a machine to meet the innumerable incidents of the sea and of naval war. The blind forces that work on ever in the same routine, in storm or calm, buried deep in the bowels of the ship, that would drive her with equal serenity against friend or foe, through the open sea or against a rock-bound coast, do *everything!* The watchful eye, the trained courage, the ready skill that watches storm and foe through the countless phases of the sea and of battle, that plan, that execute, do *nothing!* The steed is all; the rider naught! Machinery revolves the turret, disposes the heavy gun to receive its charge, brings the charge from below, enters it into the gun, brings the gun into action —therefore machinery does everything! The quick eye that seizes the fleeting moment, the calm mind that prepares and watches its opportunity, the cool temper, instinct with life in the face of death, that can suffer and knows its danger, yet is master alike of itself and of the unconscious force it guides, does nothing! Have we not all heard these sayings, with unpleasant deductions from them? But let us ask, are not we ourselves to blame for them? Have not we, by too exclusive attention to mechanical advance, and too scanty attention to the noble art of war, which is the chief business of those to whom the military movements of the Navy are entrusted, contributed to the reproach which has overtaken both us and it?

Having laid down these negative lines of limitation, the need of which has been shown by the history of the College in its early struggle for existence, we now come to such definition of its position and aims, and demonstration of its necessity at the present time, as a decent regard to the endurance of an audience will allow.

The general reply to the question, "What is the object of the War College?" will have been anticipated by you from what has already been said. It is the study and development, in a systematic, orderly

manner, of the art of war as applied to the sea, or such parts of the land as can be reached from ships. Taking the ships and weapons that the science of our age supplies, and formulating their powers and limitations as developed by experience, we have the *means* placed in naval hands by which to compass the great *ends* of war. How best to adapt these means to the end under the various circumstances and in the various fields where ships and fleets are called to act, is the problem proposed. Could we find a perfect solution, we should have a perfect theory of the way to wage war ; and, it may be added, the art of war would be a far simpler matter, and its successful conduct a much less noble achievement of man's faculties, than they actually are. Could the course of the warrior, given certain circumstances, be reduced to a rigorous demonstration, to a mathematical certainty, it would approach more closely to the mechanical, unvarying action of those blind forces of nature, in chaining which our age is fain to see its greatest glory; but in so approaching, it would part with those rarer qualities—intuition, sagacity, judgment, daring, inspiration—which place great captains among creators, and war itself among the fine arts ; and the warrior himself would descend from the artist to the mechanic.

If, however, absolute certainty in this field is not attainable by thought; if the conduct of war is controlled, not by cast-iron rules of invariable application, immutable as the laws of nature, but by general principles, in adapting which to ever-shifting circumstances the skill of the warrior is shown—are study and reflection therefore useless? Must we trust our decision in every case to the inspiration of the moment, unguided by any precedents, uninformed by any experience? Surely not. No two, perhaps, of the myriad battles of history have been exactly alike, either in the ground contested or in their tactical combinations; no theatre of war, great or small, on land or sea, is without features that differentiate it from every other, in the apprehension of the strategist; but still among them all are marked resemblances, common general characteristics, which admit of statement and classification, and which, when recognized and familiar to the mind, develop that aptitude, that quickness to seize the decisive features of a situation and to apply at once the proper remedy, which the French call *coup d'œil*, a phrase for which I know no English equivalent. This faculty may be, probably is, inborn; but none is more susceptible of development by training, either in the school of actual war, or, when that experience cannot be had, by study and

well-considered practice. Thus, a French naval author says: "The infinite number of conditions which go to make up all the possible positions in which a fleet, a squadron, or single ships may be found, causes that an officer will very rarely find himself in a position precisely similar to any one of those he has tried to foresee. Whence it follows that all suppositions as to the movements of fleets should be conformed to certain *general principles*, fruitful in consequences, the application of which to all possible positions should train the mind and fix the ideas of officers, in order that they may be early accustomed to seek out and combine all those movements, familiarity with which is absolutely necessary to them."

There have long been two conflicting opinions as to the best way to fit naval officers, and indeed all men called to active pursuits, for the discharge of their duties. The one, of the so-called practical man, would find in early beginning and constant remaining afloat *all* that is requisite; the other will find the best result in study, in elaborate mental preparation. I have no hesitation in avowing that personally I think that the United States Navy is erring on the latter side; but be that as it may, there seems little doubt that the mental activity which exists so widely is not directed toward the management of ships in battle, to the planning of naval campaigns, to the study of strategic and tactical problems, nor even to the secondary matters connected with the maintenance of warlike operations at sea. Now we have had the results of the two opinions as to the training of naval officers pretty well tested by the experience of two great maritime nations, France and England, each of which, not so much by formulated purpose as by national bias, committed itself unduly to the one or the other. The results were manifested in our Revolution, which gave rise to the only well-contested, wide-spread maritime war between nearly equal forces that modern history records. There remains in my own mind no doubt, after reading the naval history on both sides, that the English brought to this struggle much superior seamanship, learned by the constant practice of shipboard; while the French officers, most of whom had been debarred from similar experience by the decadence of their navy in the middle of the century, had devoted themselves to the careful study of their profession. In short, what are commonly called the practical and the theoretical man were pitted against each other, and the result showed how mischievous is any plan which neglects either theory or practice, or which ignores the fact that correct theoretical ideas are

essential to successful practical work. The practical seamanship and experience of the English were continually foiled by the want of correct tactical conceptions on the part of their own chiefs, and the superior science, acquired mainly by study, of the French. It is true that the latter were guided by a false policy on the part of their government and a false professional tradition; the navy, by its mobility, is pre-eminently fitted for offensive war, and the French deliberately and constantly subordinated it to defensive action. But, though the system was faulty, they had a system; they had ideas; they had plans familiar to their officers, while the English usually had none—and a poor system is better than none at all.

This decisive advantage, gained by scientific military theory over mere practical ship-handling, is the more remarkable because the French art of naval war was itself of slender proportions, and but little diffused throughout their navy. It prevailed, because the English had none until Rodney appeared. Thus, La Serre, an officer of that war, wrote: "We have several works which treat of the manœuvres of ships and the evolutions of squadrons, but we have none treating the *attack and defense* of fleets. It is possible that the circumstances in which two squadrons may meet are so varied that a regular treatise upon them cannot be made. This reason would render more interesting a work which should contain detailed and critical accounts of sea-fights which have actually occurred. Theory has already done much to teach the seaman the art of combating the elements, and every day it is adding to this sort of knowledge, but there is too great neglect to consider ships *when engaged in battle*. The infinite number of incidents which can occur during an action should not be a reason for putting aside this study. By it only can we successfully estimate what will be the effect of movements which we contemplate, and what must be done to counteract the designs of the enemy. So long as these ideas are *not familiar* to officers, the fear of compromising themselves by manœuvres will lead them to limit naval actions to simple cannonades, which will end by leaving the rival squadrons in the same respective conditions in which they were before fighting."

We are not to understand from this that the knowledge of the art of war was absolutely non-existent, but that, not having yet been written down, it existed only in the minds of a few choice spirits. Thus, Ramatuelle, another officer of that day, wrote (about 1802): "The art of war is carried to a great degree of perfection on land, but

is far from being so at sea. It is the object of all naval tactics; but it is scarcely known among us, except as a tradition. Many authors have written on the subject of naval tactics, but they have confined themselves to the manner of forming orders or passing from one order to another; they have entirely neglected to establish the principles for regulating conduct in the face of the enemy; for attacking or refusing action; for pursuit and retreat; according to position, *i. e.*, to windward or to leeward; or according to the relative strength of the opposing forces." In a word, the management of ships in battle was a matter dependent upon oral tradition, not upon recognized authority; upon the zeal of the individual officer for professional improvement, not upon governmental instruction.

These two independent witnesses—for, though brought up in the same service, one went into exile with the royalists, while the other dedicated his work to Bonaparte—agree also as to the necessity of governmental action to promote general professional improvement. Thus, La Serre says: "The instruction of a corps of officers should be directed by the Government, for if it should be abandoned to itself in this matter, some individual members might become accomplished, but the mass would remain ignorant; and the reverse happens when the Government interests itself in the matter." And Ramatuelle says: "The naval art has made, in the century which is just finished, progress which requires from officers deep and serious study. No one more than myself pays sincere homage to the knowledge and talents of those who have shed lustre upon the French navy—above all, in the war of 1778; but instruction relative to grand manœuvres was concentrated in far too few men; it was propagated only by tradition. This means was often wanting to the officer, who might have been most capable of profiting if chance had only brought him in contact with able men. It may be remarked that Du Pavillon, who had been chief of staff to Admiral D'Orvilliers, who showed superior talents in all circumstances, who is considered to have brought naval tactics out of chaos, belonged to the department of Rochefort; and that Buord, Vaugiraud, Léguille, who have exercised with the utmost distinction the post of chief of staff in the principal squadrons, belonged to the same department. It is to be presumed that the other departments would also have furnished a proportionate contingent, if they had had a Du Pavillon who might have constantly communicated to them his ideas and his knowledge." To provide for the study and dissemination of knowledge on these very matters is the object of the War College.

To return now to the positive definition of the objects of the College:

The heads under which this study of the art of war may be subdivided and grouped are numerous, and there are also certain collateral subjects, which will appear in the programme of the course, whose immediate bearing upon the effective conduct of war will not be at once apparent, and will therefore require some words of explanation in their turn. I propose, however, first to speak of those divisions whose importance is obvious and will be at once recognized, but concerning which there are some remarks to be made in the nature of closer definition, and also enlargement beyond the scope usually associated with them.

The two principal heads of division are of course Strategy and Grand Tactics. The meanings of each of these two terms may be assumed to be apprehended, with some accuracy and clearness, by such an audience as the present. There is, however, a certain radical distinction in the conditions by which each of these divisions of the great subject are modified, which I wish to enforce.

"Strategy," says Jomini, speaking of the art of war on land, "is the art of making war upon the map, and comprehends the whole theatre of warlike operations. Grand tactics is the art of posting troops upon the battle-field, according to the accidents of the ground; of bringing them into action; and the art of fighting upon the ground in contradistinction to planning upon a map. Its operations may extend over a field of ten or twelve miles in extent. Strategy decides where to act; Grand Tactics decides the manner of execution and the employment of troops," when, by the combinations of strategy, they have been assembled at the point of action.

It follows, if these definitions are accurate, that strategy, having to do with a class of military movements executed beyond the reach of the adversary's weapons, does not depend in its main principles upon the character of the weapons at any particular age. When the weapons begin to enter as a factor, and blows are about to be exchanged, strategy gives place to grand tactics. Hence it follows, with easy clearness, that "in great strategic operations, victory will now, as ever, result from the application of the principles which have led to the success of great generals in all ages, of Alexander and Caesar, as well as of Frederick and Napoleon." The greatest master of the art of war, the first Napoleon, has in like manner laid down the principle that, to become a great captain, the soldier must study

the campaigns of Hannibal, Caesar, and Alexander, as well as those of Turenne, Prince Eugene, Frederick, and other great modern leaders. In short, the great warrior must study history.

I have wished to bring out this point clearly, if briefly, for there is a very natural, though also very superficial, disposition in the Navy, at present, to look upon past naval history as a blank book so far as present usefulness is concerned. Yet few, if any, will maintain that the introduction of firearms did not differentiate the wars of Frederick and Napoleon from those of Hannibal and Caesar, fully as much as our modern inventions have changed the character of naval warfare. Take some of the points upon which strategy is called to decide, and see how independent they are of the particular weapons, which must be assumed as not very unequal between the two enemies; or, if they are unequal, that very neglect on the part of the one is a good historical lesson. Such points are: the selection of the theatre of war; the discussion of its decisive points, of its principal lines of communication; of the fortresses, or, in case of the sea, the military ports, regarded as a refuge for ships, or as obstacles to progress; the combinations that can be made, considering these features of the strategic field; the all-important point of the choice of the objective; the determination of the line to be followed in reaching the objective, and the maintenance of that line practically undisturbed by an enemy; such, and many other kindred matters, fall within the province of strategy, and receive illustration from history. This illustration will be fullest and most satisfactory when there is an approach to equality between the belligerents; but most valuable lessons may be derived also from the study of those wars, more numerous by far, in which the naval preponderance of one nation has exercised an immense and decisive effect upon the issues of great contests both by land and sea; in which, if I may so say, the Navy has been a most, perhaps the most, important single strategic factor in the whole wide field of a war.

It is obviously impossible in an address whose chief merit should be brevity, to follow far this line of thought; but I wish to throw whatever weight my personal opinion may carry against that easy assumption that we have nothing to learn from the naval past. During the three years that I have been attached to the College, my reading and thought have been chiefly, though not exclusively, devoted to Naval History, with an ever growing conviction of the value and the wide scope of the lessons to be drawn therefrom; and

I will sound again the note of warning against that plausible cry of the day which finds *all* progress in material advance, disregarding that noblest sphere in which the mind and heart of man, in which all that is god-like in man, reign supreme; and against that temper which looks not to the man, but to his armor. And indeed, gentlemen of the Navy, if you be called upon some day to do battle, it will be for the country to see that your weapons are fit and your force respectable; but upon your own selves, under God, must you rely to do the best with the means committed to your charge. For that discharge you will be responsible, not to the country only, but to your own conscience, which will condemn you if, in the eager curiosity to know how your weapons are manufactured, you have neglected to prepare yourself for their use in war.

To pass now from Strategy to Tactics. I wish first to impress upon you that the word tactics has, unfortunately, a double application. It means in one case those movements, more or less simple, by which military units pass from one formation to another, *e. g.*, from line to column, etc. As you know, there are various systems of evolutions by which these transformations are made. While the discussion of the merits of such systems is a proper subject for this College, the authoritative adoption of any system must rest with the Government.

The second application of the word tactics has, for the sake of distinction, received the qualifying epithet of "grand" tactics. It relates to combinations upon the battle-field, or in its immediate neighborhood; when strategy, having done or failed to do its work, gives place to the clash of arms. Since the weapons of the day enter here as great and decisive factors, it is evident that the method of applying the principles of war *on the battle-field* will differ from age to age. "Naval tactics," says Morogues, a French tactician of the last century, "is not a science founded upon principles absolutely invariable; it is based upon conditions, the chief causes of which, namely, the arms, may change; which in turn causes a change in the construction of ships, the manner of handling them, and so finally in the disposition and handling of fleets."

Is then the study of the grand tactics of the past, of history, useless? To answer this question let us consider what is the object of education, of study? Is it only to accumulate facts of immediate visible use? or does mental training count for much? Do not instructors at our naval and military academies recognize often that the trouble with this or that lad is not deficiency of brain, but lack

of the habit of application? Is there not attributed to the study of mathematics and of the classics a value for mental training quite independent of that utilitarian value which the American mind tends to regard exclusively? If so, the study of past tactics must have a value. For what is strategy, and what tactics, but the adaptation of means to ends? Such an end, so much force to achieve it, so many difficulties in the way—these are the elements of every problem of war in any age; while the adaptation of the means to the end by various leaders, whether accurate or faulty; the fertility of combination or resources displayed by them, are so many studies which, though they may cease to have use as precedents, nevertheless exercise, train and strengthen the mind which seeks to elicit from them the principles of war.

And herein also is the great justification of the study of land warfare as established at this institution. When we consider only the great difference that exists between the tactical units of a modern army and a modern fleet, or between the diversified difficulties of a land theatre of war as contrasted with the comparatively plain surface of the ocean, we may be tempted to think that the study of war, as applied to one, can throw no light upon the other. But even if history had not shown that the principles of strategy have held good under circumstances so many and so various that they may be justly assumed of universal application, to sea as well as to land, there would still remain the fine mental training afforded by the successive modifications that have been introduced into the art of war by great generals. They indicate the means adopted by brilliant men, either to meet the new exigencies of their day, or by some new and unexpected combination to obtain advantages while retaining old weapons; in short, they are lessons in the use of means to attain ends in war; they bring into play and strengthen those muscles of the mind which do the work of conducting war.

Between Strategy and Grand Tactics comes logically Logistics. Strategy decides where to act; Logistics is the art of moving armies; it brings the troops to the point of action and controls questions of supply; Grand Tactics decides the methods of giving battle.

There are obvious differences of condition between armies and fleets that must modify the scope of the word logistics, which it will yet be convenient to retain. Fleets, to a great extent, carry their communications with them, in the holds of the ships; while details analogous to marching and quartering troops, and to a great extent of

supplies, are not to be found with navies. Nevertheless, the question of supplies in a distant operation will assume importance. We have at least two great needs now, over and above those of sailing ships—coal and more frequent renewal of ammunition. These introduce the question of lines of supply and their protection. If, for instance, it were necessary for us to maintain military possession of a point on the Isthmus, or to conduct any great operation there, there must be a line of communication thereto. How shall it be protected? What is the best means of guarding and distributing supply vessels? Would a line of communications be best safe-guarded by sending out a large body of colliers and supply ships, convoyed by a heavy detachment of men-of-war; or by patrolling the routes by scattered cruisers always on the wing? We shall have for this at least one historical instance in our course. Again, the coal supply of commerce-destroyers is a very important question which nobody seems to care to face. It would be amusing, were it not painful, to see our eagerness to have fast ships, and our indifference to supply them with coal. What neutral power will sell us coal when engaged in war with a more powerful maritime State, and what is a commerce-destroyer without coal?*

Such are the leading features of our study upon which I care to enlarge to-day. Of less conspicuous subjects I will hastily explain their presence in the course. Hygiene, besides being by law a necessary part of instruction in every Government institution, has such bearing upon the efficiency of armed forces that its place in warfare cannot be denied. As to its usefulness to line officers, I will venture to quote words of my own: "The responsibility for the health of crews rests ultimately with the commanding officers; who, however they be guided ordinarily by the opinion of the surgeon, must be

* The following quotation from the well-known French writer on naval matters, Admiral Jurien de la Gravière, has interest for those who look to commerce-destroying as the main reliance in an offensive war. Speaking of the early years of this century, he says: "The period of disasters was about to succeed the period of captures—inevitable issue of our commerce-destroying campaigns. How could it have been otherwise? All our ports were blockaded; even before Trafalgar, English fleets covered the seas. What unrelenting pursuit had not our frigates to expect, when once our great fleets were annihilated? *It would be much worse at the present day.* It would not be long before our coal-depots would be taken from us, and we would go about from neutral port to neutral port, seeking in vain the fuel which would be everywhere denied us" (*Revue des Deux Mondes*, October, 1887).

able on occasion to overrule intelligently the professional bias of the latter." A doctor's business is to save life; the admiral's or captain's to risk it, when necessary and possible to attain a given end.

The importance of the efficiency of the units of a fleet to the efficiency of the whole, indicates the point where naval construction touches the art of war. A crippled ship affects all the tactical combinations of a fleet; a collision between two ships has ere now led to a great battle, and the results of the battle have modified the issue of a war. With the delicately calculated constructions of the present day, a single great injury to a ship's hull may affect her tactical qualities, her speed, handling, stability, to a disastrous degree. In what way and to what extent particular local injuries may thus affect her, and how they may be partially remedied in battle, are so obviously tactical questions as to need no further comment. In accordance with what has before been said, the effort has been to direct the teaching in construction toward tactical *effects*, rather than to constructional *methods* pure and simple. The eminent ability of Mr. Gatewood, who possesses not only great knowledge, but a readiness and lucidity of explanation that I have rarely heard equalled, gives me hope, if his services are continued, that we shall reach very valuable results in the tactical management of ships and remedying of injuries.

In the matter of Coast Defense and Attack, I will only say that it is intended always to have the subject treated by both an army and naval officer, in order to bring out both sides of a large and intricate question. Very different views are held on either side; those of extremists seem at times mutually destructive. If precise agreement cannot be reached, much may be hoped from dispassionate discussion, in getting rid of all differences that are due only to misapprehension. And where differences are fundamental, we shall learn at least to understand one another's meaning and reasons, to argue at least to the other man's point; not beating the air, nor laboriously overthrowing men of straw. I beg of you all not to consider a difference of opinion, however radical, to be an injury or an insult. The caution may seem unnecessary, but I swear by my experience that it is not.

And now, ladies and gentlemen, I must apologize, after the manner of speakers, for having detained you so long. If the fault has been somewhat deliberate, I hope the pardon will not be refused. It remains only to thank you for your patience, and to welcome cordially, on the part of the College, the officers who are about to follow

the course. We are here as fellow-students. The art of naval war may have a big future, but it is yet in its babyhood. I, at least, know not where its authorities are to be found. Let us take, as indicating our aim, these words of Bismarck in a very recent speech: "It must not be said," urged he, "that other nations can do what we can. That is just what they cannot do. We have the material, not only for forming an enormous army, but for furnishing it with officers. We have a corps of officers such as no other Power has." The higher we head, the higher we shall fetch.

Intended Programme of Naval War College for Session of 1888, *beginning August* 6.

Naval History considered with reference to the effect of Naval power upon general history; indicating the strategic bearing of naval power as a particular factor in general wars, and discussing the strategic and tactical use of the naval forces on their own element, as illustrative of the principles of war.—Captain A. T. Mahan, U. S. N.

The true naval conditions during the War of 1812, at home and abroad, on the sea and on the lakes; and their bearing upon the course of the war, on both frontiers and on the ocean.—Theodore Roosevelt, Esq.

Naval Gunnery: the practical use of the gun at sea and the tactical power and limitations of the weapon.—Lieutenant J. F. Meigs, U. S. N.

Present condition of commerce and commercial sea routes between the Atlantic and Pacific, with an estimate of the effect produced upon them by a trans-isthmian canal, including a view of the military and political conditions of the Pacific Ocean, Gulf of Mexico, and the Caribbean Sea.—Lieut.-Com. C. H. Stockton, U. S. N.

Naval Strategy.—Captain A. T. Mahan, U. S. N.

Strategic features of the Pacific Ocean and Pacific Coast of the United States.—Lieut.-Com. C. H. Stockton, U. S. N.

Strategic features of the Gulf of Mexico and Caribbean Sea.—Captain A. T. Mahan, U. S. N.

Strategic Study of the Lake Frontier of the United States.—Lieut. C. C. Rogers, U. S. N.

Strategic Study (outline) of the Sea-coast of the United States, from Portland, Maine, to and including Chesapeake Bay.—Captain A. T. Mahan, U. S. N.

Coast Defense and Attack.—Lieut. Duncan Kennedy, U. S. N.

Defense of the Sea-coast of the United States.—General H. L. Abbot, U. S. Engineers.

Military History, Strategy, and Tactics.—Lieut. J. P. Wisser, U. S. Artillery.

Tactics of the Gun.—Lieut. J. F. Meigs, U. S. N.

Tactics of the Torpedo.—Lieut. Duncan Kennedy, U. S. N.

Tactics of the Ram.—Commander P. F. Harrington, U. S. N.

Fleet Battle Tactics.—Captain A. T. Mahan, U. S. N.

Naval War Game.—Lieut. McCarty Little, U. S. N.

Naval Reserves, and the recruiting and training of men for the Navy.—Lieut. S. A. Staunton, U. S. N.

Naval Logistics; maintenance of coal, ammunition and other supplies to a fleet acting at a distance; establishment of depots and chains of seaports.—Lieut. C. C. Rogers, U. S. N.

General Staff; Intelligence Branch. Foreign War Colleges and Staff Academies; their relation to the General Staff. Intelligence Systems of Foreign Armies. General Consideration of Naval Intelligence Departments at home and abroad. Meaning of Naval Intelligence in detail. Strategic value of Trade Routes; their defense and attack in war. Reconnaissances. Reasons for General Staff. Essence of Intelligence work is preparation for war.—Lieut. C. C. Rogers, U. S. N.

Preservation and Care of Iron Ships and injuries to which they are liable. The Ship considered as a Gun Platform.—Naval Constructor R. Gatewood, U. S. N.

Naval Hygiene.—Medical Director R. C. Dean, U. S. N.

International Law, treated with special reference to questions with which naval officers may have to do.—Professor J. R. Soley, U. S. N.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

NOTES ON STEEL INSPECTION OF STRUCTURAL AND BOILER MATERIAL.

LIEUTENANT-COMMANDER J. G. EATON, U. S. N.

These notes make no pretense as an essay on steel. Most of their contents is already well known to experts. The writer's object is to lay before the service the facts bearing most directly on Naval Inspection. Technicalities have been avoided as far as compatible with understanding. A perusal of the clearly conceived and well worded specifications for the Maine and Texas will prove of assistance. It is essential to the purport to dwell at some length on the chemical constituents of steel. The importance of a chemical analysis cannot be overestimated.

STEEL AND ITS CONSTITUENTS.

"Steel is an alloy, fusible and weldable."

"Steel is a mechanical mixture of carbon and other substances with pure iron."

"Steel is a solidified solution of carbon with pure iron."

The specifications call for mild steel. Generally, soft steels carry the carbon below .08 of one per cent; mild steels from .08 to .20; hard steels from .20 to .40; and extra hard, or spring and tool steels from .40 to .80 carbon, and even above.

High class steel should contain only iron and carbon. Every desirable quality—strength, ductility, hardness, toughness, and elasticity—can be secured by a proper proportion of carbon. All other elements entering into the composition of steel, whether incident to the ore, or added to secure certain desiderata, are impurities. The chief of the metalloids which thus enter are manganese, phosphorus,

sulphur, silicon, and in minute proportions arsenic, copper, chromium, cobalt, and antimony. It is safe to say of them all that every useful quality gained by their presence is always counterbalanced by the loss of some valuable characteristic of the pure steel. It must not be understood that we are yet at a point where the steel-maker can totally neglect the empirical formulas by which he now obtains the desired results. But the purer the mixture of iron and carbon, and the greater reliance placed on intelligent mechanical and heat work, to obtain quality, the better the metal and the less possible, annoying and unforeseen failures. Every heating of a piece of steel leaves its record in the metal, and when various metalloids enter, the problem of so using heat and work as to benefit all and injure none, becomes extremely complex.

THE CHEMICAL ANALYSIS.

Carbon, the one essential alloy, varies closely with the strength desired. Carbon of .04 per cent gives a tensile strength of about 50,000 pounds per square inch. Carbon of .90 per cent gives say 150,000 pounds. In ship plates, angles, beams, etc., carbon runs from .10 per cent to .20 per cent. This ratio of carbon, with proper reductions in the rolls, will give T. S. 60,000 to 70,000 pounds, elongation 25 to 30 per cent in eight inches. No limit is placed upon carbon, and no uneasiness need be felt with carbon below 0.33 per cent. The required carbon point is obtained by re-carburization. The original carbon in the pig and ore being oxidized in the furnace, ferro-manganese containing 7 per cent carbon, 80 per cent manganese, and 13 per cent ferro, is generally used for re-carburizing, and is added to the heat during the run into the ladle.

Manganese, sometimes called treacherous, is largely used to exclude or neutralize more injurious elements. By thoroughly saturating the heat, manganese counteracts red-shortness, or brittleness in rolling. By uniting with the oxide of iron, manganese reduces it, becoming oxide of manganese in the floating slag. From 40 per cent to 75 per cent of the manganese disappears in this way. The presence of protoxide of iron is one of the worst causes of red-shortness, and the manganese acts as a "medicine" or purge of this impurity. High manganese produces high tensile. In ship-plate, manganese varies from 0.22 per cent to 0.60 per cent as a maximum. Very high manganese, say 8 to 12 per cent, produces an extremely hard and stiff steel.

Phosphorus is undoubtedly the most dangerous, insidious and undesirable of all the metalloids. The low cost of phosphoretic pig presents a constant temptation to the steel-maker. Apart from this, the economic effects of phosphorus are: Better and quicker melt in the furnace; more liquid pour of the heat at a lower temperature; higher elastic limit and tensile strength in the steel. The quicker melt means more time for repairs and less fuel; the liquidity at lower temperature secures less sponginess and fewer blow-holes in the ingot; higher tensile implies less mechanical work and fewer reductions. Each and all of these bear directly upon the cost.

The evils of high phosphorus are: Unequal distribution through the ingot, with consequent segregation and lack of homogeneity in the plate or shape; cold-shortness, or brittleness when bending the steel cold; and insidious weakening of parts subject to reheatings, or great vibrations. All of these defects are so well known that phosphorus is limited, or conditioned, in all material for the Maine and the Texas. In ship-plates, shapes and hull rivets, no steels carrying above 0.06 per cent phosphorus are received. For boiler plates and rivets, stay-bolts, etc., the condition permits nothing above 0.03 per cent. As both these are maxima, the maker must leave a safe margin, or run the risk of rejections. To illustrate this, the hull material for the Maine averages 0.048 per cent phosphorus, though the condition exacts only 0.060 per cent. The great advance in quality of plates and shapes in the United States may be appreciated when it is recalled that less than one year ago ship-plate averaged 0.08 per cent with a maximum of 0.10 per cent phosphorus, and shapes in excess of the plate maximum.

High phosphorus produces high elastic limit. As loads are graduated to this, rather than to ultimate strength, the steel is accepted above its true value. That is, a high phosphorus steel, showing great elastic limit, will, when exposed to shocks, vibrations, or changes of temperature, deteriorate rapidly in use. Bridge builders now condition phosphorus to 0.05 per cent in tension and compression members. In gun metals a still lower condition should obtain. The fallacy of carrying high phosphorus with low silicon will find few adherents. In rails the percentage of phosphorus is 0.10. This seems requisite to give a hard wearing surface and prevent scalping. Comparatively few rails break, but the ideal rail is one with a hard bulb, and tough web and flange.

I have dwelt particularly upon the dangerous characteristics of

phosphorus, as there are not wanting those who assert that phosphorus up to 0.07 per cent is beneficial. One year ago these same "self-luminants" placed the limit at 0.10 per cent. I have been able to trace many "mysterious" breakages home to phosphorus, and unless the history of the heat is known, always suspect it. The only good word I can find to say for phosphorus is, that its metals are more adversely affected by cold rolling, and give unmistakable evidences of this serious defect—somewhat on the principle of administering poison to produce a rash.

Silicon, as an alloy, is useful in securing more solid castings, preventing blow-holes and sponginess. Its useful qualities beyond these are doubtful. A high percentage is *now* frequently found in tool steels without injury to the edge. In ship-plate, the silicon of the pig is usually consumed in the furnace, and the remaining percent is very low, say not exceeding 0.04 per cent.

Sulphur causes red-shortness or brittleness in hot working. This is so obvious and fatal a defect that it cannot escape notice. Sulphur rarely exceeds 0.03 per cent.

Arsenic, in large proportion, causes cold-shortness and great brittleness. Copper causes red-shortness. Antimony combines the evils of both arsenic and copper. Silver and cobalt are rarely present beyond a trace.

CHARGING AND MELTING.

Apart from the chemical knowledge of the heat, an inspector should have a good general knowledge of the composition of the furnace charges. Variations in the pig and mill irons, blooms, crop ends, scrap and ores that all go to make up the heat, are surely recorded in the resulting steels. Any sudden change in the character of the plate may be referred to the charge. To illustrate: a series of surface defects, snakes, pittings, and laminations was traced step by step from the roll train, through the rolls, heating furnaces, casting and melting, till the cause was finally located in the too great proportion used of acid-washed metal. The proportion of this was reduced from 50 per cent to 5 per cent and the defects ceased. The chemical analysis showed the same before and after. The inspector has no authority over what shall be charged, but the books are open to him, and should he suspect evil in any of the charges, the specifications provide for extra tests to assure himself that the steel is uniform. These additional tests will either justify his suspicions and reject the heat, or dissipate his distrust.

Ordinary open-hearth furnaces run two heats each 24 hours. The melt is usually tapped into a ladle previously heated to prevent chilling, and thence teemed into ingot molds. The ingots vary in weight from 500 pounds to 30,000 pounds, and the cross-sections from 4×6 inches to 36×48 inches. Ingots are either top cast, by pouring directly into the mold, or bottom cast by stand and runners. Each method has its advocates. For small ingots the bottom cast is best. Whilst the heat is teeming, and near the middle time, a test ladle is taken for chemical analysis. Should the inspector desire, test ladles will be taken at the beginning and end also. Wide variations in these tests show poor mixtures and segregation. Specimens pulled from such a heat represent only the ingots from which they are taken. In such a case, test each ingot independently.

From the ingots thus cast the inspector should select the four poorest for test plates. These ingots are charged, when cold, into the heating furnace. When raised to the proper working heat, as determined by the heater's eye, the color varying from light yellow to white, according to the carbon, the ingot is hauled from the furnace and placed upon the rolls. The ingot is usually coated with a loosely adhering scale, that cracks and falls away at the first pass through the rolls. Each roll-pass accomplishes a reduction in the vertical section, large at first, and decreasing in draught as the temperature decreases. Four passes are made longitudinally, then the ingot is turned and rolled transversely, then "cornered" to bring out square-shouldered plates; after which it is again placed longitudinally and finished to the required thickness, the transverse passes giving the proper width. These remarks apply only to plates, as all shapes are rolled entirely longitudinally. Mill scale is swept off by brooms, or, if very obstinate, is blown off by salt liberally sprinkled on the glowing surface of the plate. As the salt passes through the rolls the explosions dislodge the objectionable scale. Plates are very free from scale defects on the lower side; scale defects cause ridges and produce rough, corrugated faces.

Very much depends upon the heater's skill. A poor heater will burn or overheat the ingots. A burnt ingot has not only lost a per cent of steel oxidized, it has also changed the size and form of its crystals. These enlarged crystals cannot be reduced in a rolling mill, and will cause weak sections. Overheated and bleeding ingots produce pits and laminations that no subsequent rolling can eradicate.

Cold rolling comes either from insufficient heating or too rapid

cooling below a working heat. Look for this defect in thin wide plates. The injury to the plate or shape is due to the draught of the rolls, causing a cold flow of metal, entailing injurious strains and stresses, and reducing elongation.

SURFACE INSPECTION.

An inspector provided with a long-handled light hammer, pointed at one end, should be always at the rolls. Most surfaces are covered in a short time with red or black oxides that effectually conceal serious defects. True, these defects come to light in pickling, but it must be humiliating to any inspector to depend too much on this. Therefore, inspect plates and shapes as hot as possible. The principal surface defects are laminations, hair cracks, scale marks, scabs or blisters, pits, snakes and cobbles. Probably 75 per cent of surface defects are due to pitting. Pits are conical cavities extending towards the centre. If their depths are at all considerable, they are fatal to acceptance. Their cause has been noted. Should cinder or pieces of fire-brick be rolled in, a spotted appearance will indicate their presence. A sharp tap of the hammer will dislodge them and show the extent of the injury. Bits of slag are discovered by fine hair lines marking their areas. The hammer discloses their size and shape. Scale cools more rapidly than the plate itself and produces hummocks. Cracks are found in the direction of the rolling, and give indications of blow-holes long drawn out. To ascertain their injury, test transverse specimens. Snakes, on the contrary, as their name implies, are twisted in every direction. It is accepted that they are caused by some foreign substance, such as peroxides or protoxides of iron formed in the heat, separating two masses of pure steel in the ingot. No amount of work can cause a true union or weld across this flimsy layer. Once in the ingot they reappear in the plate. So true is this that an ingot known to be snaked is cast aside for scrapping. A snake is fatal, and no material *for any purposes* should be accepted where snakes are evident. The application of a fine file will soon settle doubtful cases. In general, high carbons produce more snakes, but poor melting is the prime cause. It is a noteworthy fact that a record of two hundred and fifty basic heats, of thirty tons each, did not produce a single snaked plate.

Laminations occur both on the surface and at the edges. Surface laminations may usually be traced to chipping the ingot. The cavity thus formed is covered by overlapping edges. A few blows of the

hammer will cause these overlaps to separate into sheets. If proper allowance is made in width for shearing, a properly rolled ingot will never laminate. All plates should be inspected after shearing for laminations. Cobbles are produced by unequal heating of the sides of an ingot. Under the same draught the hotter side creeps faster, producing ridges. This defect cannot be remedied. It will be recognized by the diagonal trend of its ridge or crest. Simple slight waves in a plate are not serious.

SHAPES.

Shapes, such as deck-beams, angle, T and Z bars are usually free from pits, scales and snakes. The blooms or billets from which they are rolled have small sections, and permit more perfect heating and better cleaning in the rolls. Owing to the small section, sand is frequently used to prevent slipping. Look for sand scabs, laminations caused by overlaps, grooves and wire edges. Many beams are rolled with web eccentric to the angle. Reject these. Measure carefully the width of angle, as beams run scant near the ends. The same rule holds good as to angle bars. Watch for shady backs. Reject all shapes which are not full to true section. In bulb beams especially the angles are frequently cold drawn by the more rapid travel of the metal in the web, due to its receiving a great deal of work after the flange is fairly formed. The billet is symmetrical, but the finished beam, unlike I beams, contains 25 per cent more metal below the centre of the web than above. The injurious effect of the cold flow causes wire edges, and sets strains, that in many cases fairly equal the strength of the metal. A beam thus rolled might easily shiver to pieces on being thrown from a car. Proper annealing would restore the crystals to an amorphous condition and relieve the strains. There would be an apparent loss of tensile strength, but the actual working strength would be increased. In angles of unequal sections and Z bars the above strains obtain, but to a less extent. The Navy demands peculiar sections. The manufacturer is loth to turn new rolls at great expense; he therefore resorts to old rolls approximating the shape. The steel thus shaped is badly rolled. More passes and smaller reductions cause cold rolling. It sometimes happens that unusually large sections stall the engines. For all these reasons, the inspector should see the more important shapes rolled. Test specimens for shapes are taken from cropped ends, which are poorer than the rest of the shape, but an inspector will do well to cut his tensile tests, and in all cases his bending tests from the angle, and *not* the web.

TEST SPECIMENS.

The plate or shape having passed surface inspection, the specimens are stamped with heat number, ingot number, and inspector's initials. These specimens should come from near the edges of plate or shape. Four tests come from each of the four test plates. This allows duplicates in case of faults. Ingots are tapered to facilitate stripping. Hence the bottom of the ingot has a greater cross-section than any other portion. Moreover, the steel is more compressed and solid at the bottom than at the top. Both these causes contribute to give a better steel at the bottom end of a plate than at the top. To obtain a specimen which shall show, not the average condition, but *the poorest part*, cut from the top part. Let me emphasize this; the inspector should always bear in mind that his search is for the worst features of the finished steel. The strength of a plate is the strength of the poorest cubic inch it contains. There is no average strength. The value of a plate is the value of its weakest section. "The weakest part must bear the strain."

As showing how tensility and elongation vary in the same plate, I cite a remarkably well rolled plate at the Homestead Steel Works, which showed T. S. rising in eighty inches from 49,000 pounds at the top end to 51,800 pounds at the bottom. The elongation fell in the same distance from 32.71 per cent, top end, to 29.8 per cent at the bottom end. The reduction of area fell from 66 per cent, top end, to 60 per cent bottom end. These results, in each case, were the mean of six tests taken side by side. In all thirty tests were pulled from this one plate. The plate gauged $\frac{3}{8}$ of an inch, and was rolled from an ingot 10×18 inches. The taper gave 27 reductions for bottom end, and 26 for top end. The true value of this plate was T. S. 49,000, elong. 29 per cent, red. 59.6 per cent, or the value of the poorest test specimen.

In inspecting plates rolled from slabs, from large ingots, *i. e.* ingots weighing from 8000 pounds to 30,000 pounds, cut the specimens from the upper end of the slab, not only for the reasons above, but also for the graver one, that the segregation of the metalloids increases with great increase in size. The slower an ingot cools, the greater the segregation. Large ingots presumably cool slowest. Remember, however, that segregation is largely a question of temperature in pouring. The lower the temperature of the pour, the less the segregation. Large ingots can be cast very rapidly owing to being top

poured from a large orifice in the ladle, consequently the temperature in the ladle is much reduced without danger of chilling. The ingot which developed the most segregation, of any I have seen analysed, was a pigmy, 10 × 18 × 30 inches. Surprising variations occur, notably in phosphorus and carbon. The tensile strength, elongation and elastic limit in the same ingot vary widely. As an illustration I give here two tests from opposite ends of the same plate rolled from a slab:

Top end T. S.,	64,500 lbs.	Elong. 19 per cent.	Red. 31 per cent.
Bottom end T. S.,	55,400 "	Elong. 26 "	Red. 48 "

Evidently the value of this plate is

T. S., 55,400 lbs. Elong. 19 per cent. Red. 31 per cent,

a poor result for ship or boiler plate.

The chemical analyses of these specimens disclosed:

Top end,	Car. 0.31	Phos. 0.075
Bottom end,	Car. 0.17	Phos. 0.050
Heat test,	Car. 0.15	Phos. 0.044

The bottom cold bending piece closed on itself without a crack, whilst the top specimen broke short off at 170°, with a fracture indicating high carbon, with large weak crystals.

For test specimens for ship and boiler plates, and shapes, the piece is cut 16 inches long, with parallel planed sides, and a cross-section from 0.5 inch to 0.8 inch. The witness marks are eight inches apart. For ordnance and protective deck plate a filleted round is prepared. The ordnance adheres to two inches between witness mark, which secures an elongation about 30 per cent above that of the eight inches. Rounds generally give better results than flats.

Specimens are measured in three places to give mean section, these measurements being made with micrometer gauges which register the thousandth of an inch. Twelve one-inch witness marks should be punched on the edge. The specimen is then placed in the grips and the initial stress applied. Additional loads are added at short intervals, the beam being kept in equilibrium. Elastic limit is marked by unsteadiness of the beam ending in a sudden drop. The cracking of the mill scale is also a good, but not infallible, indication. From this time the loads are added until the ultimate strength is reached, as shown by the beam refusing to rise. These last loads should be added very gradually. From this on, the specimen stretches and

necks until fracture occurs. The fractured ends are carefully fitted and the specimen measured as before. From this second measurement is obtained elongation and reduction of area. Examine carefully the nature of the fracture. Cup fractures, with fine crystallization and uniform gray color, indicate homogeneous, well rolled, metal. Sliding fractures occur frequently, but are not as favorable. Irregular, jagged fractures are bad. Mottled colors, parti-colored streaks, bright spots and dark patches all indicate poor steel, and should arouse suspicion however high the ultimate strength or the elongation. Coarse crystallization betokens insufficient work, high phosphorus, or burned metal. Bright patches and streaks denote segregation and cold rolling. Dark, irregular blotches evidence overheating.

Heat the quenching specimen to a dark cherry red in a fire free from smoke, or better, in a small gas furnace. When of a uniform color, plunge into water warmed to 82°, then bend cold till the centre doubles around a curve three halves the thickness of the piece in diameter. Quenching properly performed will detect cold rolling, brittleness and segregation due to phosphorus. A well rolled plate will bend double after quenching without cracks.

Cold bending requires the piece to close on itself without cracking. Very few specimens fail under this test. Thin plates will fold twice without fracture. Rivet steels are required to be cold flattened and hot flattened under a hammer. One specimen is additionally bent like a hook. With low tensile *and* low phosphorus, any failure in these easy conditions should be fatal.

TESTS FOR SHAPES.

The tensile and elongation requirements are the same as for plates, also quenching and cold bending. In view of the additional tests, this latter might safely be omitted. The additional tests are cold opening, cold closing, and drop test. I have already called attention to the unwisdom of accepting tensile tests from the web. These are uniformly superior to those from the angle. The opening and closing test of beams is one operation. Closing one angle opens the other. Much trouble was experienced in this test, of the IX-inch battery bulb beams, for some of the cruisers. Most of the beams broke short off in the web, close to the fillet, whilst a few cracked straight across the flange. These beams were rolled from unconditioned Bessemer steel, and the fractures disclosed large, weak, fiery, bright crystals. Over two hundred beams were rolled to supply one lot of thirty-eight. In

the Maine and Texas, the phosphorus must not exceed 0.06 per cent, and the material used must be ordinary open hearth. Angles must both open and close. Of these, few fail in opening, the closing test being the more severe. Failures occur at the fillet near the jaw or apex. The present drop, or shocking, test affords an excellent criterion as to the amount of brittleness. A 5-inch × 3-inch × 9-pound reverse bar O. H., for the Maine, stood thirty-three blows from a 640-pound weight dropped five feet. The bar was inverted after each blow. The deflections up and down varied from five to seventeen inches. The bar showed fatigue at the twenty-fifth blow, and fine hair cracks developed in the heel at the thirtieth blow. Rupture occurred at the thirty-fourth blow, by the steel tearing, not splitting or cracking, half across the narrow angle. Three more blows were necessary to carry the fracture across the heel of the angle. The bar was by this time so twisted and flattened as to have lost all semblance to its original section. Similar experiments, with punched bars, showed that the fractures rarely extended into the holes, though grazing their edges. Ships, framed with such material, will stand a deal of bumping, battering and ramming before breaking.

BOILER PLATES.

The remarks, as to ship plate, apply equally to boiler plates. High-boiler or shell plates are required, in the Maine and Texas, to have an elongation of 25 per cent in eight inches. This is a march, not a step, in advance. The previous specifications called for only twenty per cent. Owing to the great size of the ingot, and greater difficulty in proper heating, there are more pits and laminations. The remedy for this lies in narrower plates and more of them. The shell plate for Cruiser No. 5 boilers are $1\frac{3}{32}$ inch thick, and weigh, finished, 4900 pounds each. More failures occur in shell plate than all other material combined. Flange plates (low boiler) are required to have an elongation of 29 per cent, and rarely fail. Boiler plates are planed, not sheared, to true dimensions. Be especially careful as to laminations in boiler material.

The desire to secure increased tensile strength in boiler plates is to be deprecated. No high steels are as dependable as mild steels, and any gain in pressure in this way is dangerous.

CONCLUSIONS.

The specifications are as rigidly drawn as the Articles of War or

Navy regulations. To the precisian, they mean reject on any failure, or accept on any passing. To others, many doubtful cases will arise. The fault or success may be a quality of the specimen, and not of the piece itself. A careful inspector will want all the data obtainable, before rejecting or accepting. Attention is called to the wonderful persistence of like chemical constituents producing like physical qualities. If space permitted I could attest this statement with records of five hundred heats. Look first to the analysis, and after to physical errors for defects.

All structural steels for the Maine and Texas are ordinary open hearth. Boiler plates also open hearth. Rivets, either Clapp-Griffith (a modification of Bessemer converter) or open hearth. The steel castings for the Maine will be Bessemer; those of the Texas open hearth.

The significance of the specification, "ordinary open hearth," will not escape notice. This clause shuts out "basic open hearth," now being extensively used. The Steel Board has preferred to hold fast to that which is proven; but the trade is not so conservative. Basic material is fast making its way into every channel where steel is used. The Baltimore & Ohio and Pennsylvania railroads use it extensively for fire-box steel for locomotives. The large Globe Boiler Works have adopted it. It has been my fortune to witness over two hundred basic heats. I have seen the charging, the melting, casting, reheating, slabbing, rolling, testing, and bending. The ingots seem more porous than those from ordinary open hearth, but the holes weld in rolling, and the plates are homogeneous, and remarkably free from snakes, pits, and laminations. Physical tests compare favorably with ordinary open hearth. All of these statements refer to basic steel below 0.20 per cent carbon. Owing to the greater purity of the heat, basic steel requires at least two points more of carbon to produce tensile equal to acid heats.

Time was when crucible steel alone was considered reliable; open hearth is now a standard. Bessemer is still struggling to establish its reputation as a dependable metal. Its bastard, Clapp-Griffith, has come into Navy circles ahead of its progenitor, on rivets. Basic steel is still shut out, but its process is so rational and its product so reliable, that it will not be long ere it comes to the front.

There can be no shadow of doubt that the Navy is now obtaining for its latest additions, a material superior, in every good quality, to any other ever used in any ship. I make no exception whatever. It is

a subject of congratulation, that from the Advisory Board of 1883, to the present day, the Navy has taxed the resources of the steel-makers to produce a quality of metal superior to their best. The requirements have been severe, the inspection rigid; but it is gratifying to note how the steel has successfully advanced to meet both. The specifications for Cruisers 1 to 5 and the four gunboats were denounced as impracticable and absurd; but now the much more severe specifications, for the Maine and the Texas, are accepted and carried out with thoroughness and cheerfulness. All attempts to set aside or reduce the qualifications have been firmly resisted by the Secretary of the Navy, and the Steel Board is laying the foundations for ships which will float or fight, with the best material on any ocean or under any flag.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

AN ESSAY ON THE TACTICS OF THE GUN, AS DISCOVERABLE FROM TYPE WAR-SHIPS.*

By Lieutenant J. F. Meigs, U. S. N.

Any seaman who, without knowing how Ruyter, Benbow, Hawke, Nelson, and, of our own navy, McDonough and Perry, fought their ships, could, by an examination of the types of vessel used, determine with a high degree of probability what their tactics were. What these tactics were in the main; for, of course, commanders used the force under their command in a way differing slightly from each other. Without these differences, sea tactics would become an exact science, every possible feature and operation of which might be laid down in a closet on shore, and naval officers might dismiss the further consideration of the subject from their minds.

From about the middle of the sixteenth century to nearly the middle of the nineteenth—from about 1550 to 1850, a period of only 300 years—the principal tactical features of ships remained the same. The limits of this historical period, usually called the Period of Sails, are roughly marked by the sailing of the Invincible Armada in 1588, and the outbreak of the Crimean War in 1854.

Any one skilled in the tactics of sea battles, being shown one of the vessels of this period, would say—after possibly a good deal of reflection, if the question were presented to him for the first time—those ships must fight with their beams presented to the enemy, and they must not allow him to get much before or abaft the beam, for the arc of train of their guns is very small. He would say also—as a ship is more manageable when close-hauled than when on any other point of sailing, it will probably be best for fleets to fight in close-hauled line ahead, and probably for single ships also to fight

* The subject-matter of this essay formed a part of a series of lectures on Naval Tactics as Controlled by the Gun, delivered at the War College, at Newport, R. I.

close-hauled, so far as these need to lay down any rule for their guidance in battle. Our supposed tactician would thus lay down the tactical rules that these vessels would each adopt an angle of presentment* of nearly 90°, and that fleets would fight in a single line ahead, the direction of the line being six points away from the direction of the wind: and it may be noticed that the substitution of steam for sails has almost entirely relieved us from any consideration of the direction and strength of the wind, and has thus simplified the tactics of the sea—sea-tactics, which have always been so much simpler than tactics on shore, from the absence of those accidents of the ground and buildings and cover of various kinds which are found on all battle-fields, became by the introduction of steam, so far as its locus or theater is concerned, of ideal simpleness.

To get at a correct idea of the tactics of the Sail Period, we must know, besides the angle of presentment, the distance at which ships fought. And we ask our tactician to discover, without reading naval history other than the history of the material used, what the ordinary fighting range of the Sail Period was. This, if he knows the thickness of the sides of the ships of that period, and the penetration of the guns, he can approximately do by assuming that ships whose captains mean business will come so close that their guns will penetrate the sides of their antagonist. Or he may assume that a more deadly range will be taken up—that at which the fire of musketry will be effective. Thus, with a table like the one below, which gives the penetration of various shots into seasoned white oak, the fighting range can be approximately determined:

Name of Gun.	500 yards.	1000 yards.	1500 yards.	2000 yards.
		Penetration in inches.		
18-pounder, long	29	18	11	7
24-pounder, "	34	22	14	9
32-pounder of 33 cwt	26	19	13	9
" " 42 "	32	22	15	10
" long	39	27	18	13
42-pounder	42	30	21	15
64-pounder	50	37	28	21
8-inch of 55 cwt	29	20	14	10
" " 63 "	33	23	16	11

This table is from Dahlgren's Shells and Shell Guns. It is also contained in page 240, Simpson. It is fuller in both these books.

* The angle of presentment had been defined to be the angle between a ship's keel-line and the line of fire.

It may be added, in reference to this table, that the muzzle velocities are higher than they probably ruled throughout the Sail Period; and that, therefore, the penetrations are also probably greater.

From this table, as roughly amended by such scant historical accounts as we have, and from our knowledge of the history of caliber in guns and of shipbuilding, it is fair to assume that no material harm could usually be done by ships to each other at ranges greater than about 200 or 300 yards at the beginning of the Period of Sails, or greater than about 500 to 700 at its end. We have thus reached the conclusion, from the history of types of ships during the Sail Period, that fleets fought in a close-hauled line ahead, with the enemy right abeam, and at a distance increasing from 200 to 700 yards.

All of this seems very simple to us now, because by our reading of history we were supplied with the key to the problem in advance. And so, perhaps, in 50 or 100 years will the appropriate tactics for the ships of to-day seem. But, in order that they shall seem simple, it is necessary that the *types* of war-ships, which have not as yet perhaps taken the forms they are destined to keep, shall show out a little more. We have, shading down by almost imperceptible gradations, battle-ships, armored cruisers, protected, unprotected, and partially protected cruisers, ram and torpedo cruisers. And then, with no clearly drawn line to separate them from the foregoing, come the gun-boats and gun-vessels, protected, unprotected, and protected in part; torpedo boats, torpedo avisos, torpedo catchers and hunters, sea-going and coast-defense torpedo boats, etc., in an apparently inextricable confusion.

The question which it is hoped to answer in some degree in this essay is—have any of these types tactical features which are permanently grafted on ships. If this question cannot be answered beyond all doubt, as may not improbably be the case, an important end may yet be reached by the examination of the prominent tactical features of a number of recent war-ships. Such a study may be called an inductive tactical study: it is an attempt to ascertain from the views of a number of men who have given much attention to the subject of sea-fighting, as embodied in the ships they have built or designed, whether there is a consensus of opinion upon points of vital interest to sea officers.

The attempt to build up deductively tactical science from an examination of the inherent features and qualities of the gun, ram, and

torpedo; from the actual state of ship construction, and the actual possibilities of moving and controlling ships, is another way of reaching the end desired.

The subjects which come before us in an essay on Gun Tactics are the amount, kind, and distribution of guns; and the protection afforded the ship's fighting efficiency by structural arrangement, whether of iron armor applied or what not. We are not concerned with the building of the ship's ram bow, except in so far as it affects her handiness; nor with the cellular construction of ships, except as this controls the inflow of water through a shot-hole at the water line. Before, however, examining the guns and armor of existing ships—their powers of offense and defense, so far as the gun is concerned—it will be of advantage to examine, in such manner as is possible, the guns and armor of ships of an earlier date than our own.

Broadly speaking, the power of the offense seems to have steadily gained on the sea, as compared with the defense, from the earliest times of which we have record. This statement is borne out both by what we know of weapons of offense and defense at different times, and also by the greater duration and less fighting range of battles in former times than now. Men cannot stand more than a certain amount of punishment, and, though this amount may vary slightly from age to age, from causes depending upon differences in physical and mental condition and education, yet, in the main, short battles and long ranges show that the offense is stronger than the defense; while the reverse is indicated by the opposite.

The sea battles fought under oars in the Mediterranean between about 500 B. C. and 1500 A. D.—between the battle of Salamis, say (480 B. C.), and the battle of Lepanto (1571)—were all long contests, fought at very short range. These battles lasted the whole of one daylight, and even longer in some cases, and the fighting stage of them, as distinguished from the manœuvring stage, occurred with the vessels nearly or quite in contact. In these battles, particularly in those between the Greeks, in the earlier part of the period, a high degree of tactical skill was displayed, and the ram was often used with telling effect; whilst in those later on—those in which the Romans took part, and then again, after a long lapse of centuries when there was little sea fighting in the Mediterranean, at the battle of Lepanto—the fighting was almost altogether hand to hand.

It may be worth while, at this point, to inquire what effect tactical skill has upon the duration of combats. On the open sea, tactical

skill consists in bringing a force into collision with the enemy in such a way as to obtain the full advantage of it, and in parrying the enemy's attempts to do the same. And it is clear that an increase of tactical skill will shorten the fighting stage of combats, whether the increase be on the side of one or both combatants. As we run our eye over the history of battles, whether on the land or sea, we recognize in all of them an epoch at which the real fighting begins—at which the fencing and sparring of the two commanders cease, and, the two forces being brought within reach of each other, the fighting of the units of the force begins. After this instant, tactical order is largely lost, and the work of the commander is over.

I venture again to wander a little from the subject immediately in hand, to point out how rarely seamen have been tacticians. This may be instructive to us, and it may contain a warning to us. The men who commanded our ships in the War of 1812 were skillful tacticians, and had deeply studied that important branch of our profession. Nelson, De Ruyter, and Rodney were tacticians; so were some of the French leaders of the eighteenth century; but seamen have notoriously neglected the subject of tactics—have, indeed, often regarded it with a tinge of contempt. The men who commanded the rowing fleets of Greece and Rome, as well as those which fought at Lepanto, and many of the earlier sailing fleets of England, were soldiers, bred to land fighting. Robert Blake, one of England's greatest admirals, was trained in the army, and first went to sea at the age of about fifty.

To resume now our proper subject. As we leave the wars of the Greeks and come down to times nearer our own—to the fierce battles waged in the northern waters of Europe in the tenth and eleventh century, and to the battle of Lepanto—it may, perhaps, be true that the offense has lost a little. At Lepanto there were a number of guns carried by the galleys, and these must have given great power to the offense if properly handled; but in the battles fought in the Middle Ages by the Norsemen, the offense was not strong. The war vessels used in these latter combats were not larger than a frigate's launch, and were doubtless more or less undecked. Also, probably, from the irregular manner of raising these fleets and from the considerable independence retained by the smaller commanders, they lacked the compactness and discipline of present national navies, and thus also lacked the power to make effective tactical combinations.

The duration of these battles was often two or three days and the

fighting range extremely short. This would indicate that the offense was weak, and thus does not agree with the statement already made that the offense has gained slowly on the defense. The offense did, then, suffer a set-back in the Middle Ages; the art of sea warfare, in common with other arts, suffered a serious check when the Grecian and Roman civilization were overthrown.

There is a truth of general application with reference to the history of the offense and defense in sea warfare which it will be of advantage to note here: it is that the defense becomes stronger as the ship becomes larger. Not, perhaps, from any settled tactical conviction that this should be the case, but because large ships require thick sides in order that they shall be as strong as smaller vessels. We often hear now of the unsinkable, impenetrable war-ship; and the British Admiralty estimated in 1886 that such a ship would cost about $9,000,000, and would therefore be of about 23,000 tons displacement. We may note that from the time of Drake and Raleigh—the middle of the sixteenth century—when it may fairly be said that sailing ships had assumed the principal features which they wore during the next 300 years, ships continued to increase steadily in size. Thus the "protection," to use a word totally unknown to the seamen of the time, of ships continually increased; but, at about the date just fixed, the installation of guns on shipboard had assumed an effective phase; and, not many years later, the line of battle, of which we see nothing in the destruction of the Invincible Armada, began to be used by sailing ships. Thus, while the defense gains from the thickening sides of ships, the offense gains from the increasing number and power of guns and from the improvements in tactics.

To sum up then—as we run our eye over the scant records which exist of sea fighting from the battle of Salamis to the time of the Invincible Armada—a length of time compared to which the duration of the tactics of Ruyter, Nelson, and Perry is very insignificant—we see that the oar was generally the motive power used by ships in battle, particularly in the narrow seas; that ramming was much used, and with great skill and effect by the Greeks; that the fate of the day hung largely, however, upon hand-to-hand fighting, and, on the whole, particularly after the introduction of guns, the offense gained relatively to the defense. That there were many balancings between the two main elements of fighting power, many and wide oscillations to and fro, cannot be doubted. But it appears to be true, broadly speaking, that at the same fighting distance, battles were shorter; or

that, if their duration was about the same, as I am disposed to think was the case, the fighting range was greater.

Whilst then, in the 2000 years which elapsed between the battle of Salamis and the sailing of the Invincible Armada, we have few lessons which are applicable to the question of guns and armor in its narrower sense, this period shows us with regard to the broader question, that between the offense and defense in sea battles, the offense was gaining slowly.

There is one other point regarding the history of naval operations during the long Oar Period, as it may conveniently and with sufficient accuracy be called, which, though it has no immediate relation with the history of the strife between the offense and defense, may yet find a place here. I refer to the close relations which then existed with the army and land operations in general. Many of the men embarked in fleets—the majority of the leaders, it would appear, indeed—were equally soldiers and sailors. Voyages were generally shorter, so that fleets were punctual in their movements; and there was less fear of the land than in the Sail Period, principally because the voyages were generally coasting, and so the land was always kept aboard. Does not the situation approach that which now confronts us? We navigate the ocean, and not inland waters; but, moving at high speed, our voyages will be short and our movements punctual. Thus, from the simplicity, in one respect, of our environment, we shall be expected to keep touch with the army, and our training must keep this in view. The days of long sea voyages, of the isolation of the seaman, have gone by; many of our naval exercises and drills take place at first most appropriately in port, and, after we have become sufficiently expert there, we try the same thing at sea. Some of our drills, again, take place only in port. Thus, in plain English, we shall be less in blue water than the men who navigated sailing ships—a less time, but shall probably cover a greater distance. Shall it be said, because of this, that we are less seamen than those who went before us? By no means, no more than it is said that the hardy fisherman who goes on the water daily in his small and flimsy craft is less of a seaman than the man who passes his life in the stately wheat ships that ply between California and the shores of the Atlantic, or in the great steam liners that now carry so large a part of the over-sea commerce of the world.

It would be most interesting to know what the contemporary opinion as to the effect of the introduction of cannon upon sea

warfare was. Seamen probably held that it was murderous, perhaps inhuman and barbarous, in much the way that many officers of our navy held the introduction of torpedoes in the Civil War to be barbarous and inhuman. And yet, if historians may be believed, the effect of these improved engines of war is to spare human life, to increase the importance of the tactical part of battles, and to shorten the fighting which follows when the tactical stage is wrought out, first in the council and draughting rooms, and afterwards by the commander on the field of battle. Such a view, moreover, appears reasonable.

The effect of the introduction of guns upon the contest between the offense and defense was most marked. Coming, as it did in some sense, simultaneously with the attainment of some perfection in the art of rigging sea-going ships of large size with sails, the change was as great as that caused by the introduction of steam, shell-guns, and the torpedo; though it was perhaps not accomplished in so short a time. We must carefully avoid, however, the impression that any great change in material, whether intended for peace or war, is effected suddenly. Guns were first used afloat in 1372; but port-holes were not invented until about 1500—a century and a quarter later—and though the evidence is not perfectly clear, there can be no doubt that it took naval guns a full century to come to anything like maturity. Shell-guns* and steam propulsion have taken about the same time to grow to their present state; while torpedoes, effectively used a full century ago, and of unquestionable service during our Civil War, still find among naval officers those who believe in their very limited use only.

No further striking changes occurred during the period of sails. The size of vessels increased slowly, as it was found that large vessels permitted concentration of power for war and better freights in peace; and the guns improved, no doubt, in power. We have very little accurate knowledge of the power of the guns used during this time. The habit, of ascertaining muzzle velocities and other ballistic elements at proof, came in afterwards, and we must accept, for want of anything better, such indirect evidence as exists. We know that the equipment of guns grew better slowly; the history of the battles of the period warrants the statement that the offense gained on the defense.

*As against the argument that shell-guns attained their full development long ago, it may be urged that at present there is no good shell, much less shrapnel, fuze.

From the table of velocities of smoothbore guns already given, we may conclude that no material harm could be inflicted by ships at greater ranges than about 200–300 yards in the time of the great Dutch and English maritime wars—the time of Blake, Van Tromp, and De Ruyter. A hundred years later, when Hawke, Anson, and Boscawen were at the head of the British navy, the calibers of naval guns had changed very little; the larger ships carried a few 32s and 24s, but the greater number of guns afloat were 9s and 18s, and of even less caliber. As to the velocities of the projectiles we know very little; but from the want of attention to this important element of ballistic power, we may conclude that the velocities were low. This view, too, is strengthened by the frequent complaints of naval officers of the inferiority of the powder furnished to ships—a fact which they observed from the failure of their shots to penetrate the enemy's side in battle.

Even as we proceed to a period later than the middle of the 18th century—to the time of Howe, Rodney, Jervis, Collingwood, and Nelson—we find no sharp change. These men sometimes pounded their enemies with the fifty or more guns which the heavy ships carried on one broadside, for three or four hours, when within pistol shot—50 yards. The Berwick, Hawke's ship in Mathews' action off Toulon in 1744, battered the Poder for four hours within pistol shot. Collingwood, in the Royal Sovereign at Trafalgar, lay with his yard-arms almost touching those of the huge Santissima Trinidad for as long. We cannot suppose that a great many of the shots missed the immense target presented, and are therefore forced to conclude that many of the shot failed to penetrate. The guns of these ships were well and rapidly served, too. Collingwood used to tell his men that "any ship which could fire three well-directed broadsides in two minutes was invincible." Note here that this great commander evidently appreciated all the elements of effective gun-fire: the guns must be served rapidly, must be well aimed, and the firing be by broadside. It is not meant to conclude from this remark that the firing of all English ships of that time was strictly by broadside, but that the first shots were fired in this way, and that it was understood that a ship, which had made a serious impression on her enemy by firing a few broadsides in this way at short range, had half won the battle. The handling of the Victory's guns at Trafalgar, and many other cases, bears this out.

Whether it was from a full appreciation of the want of power of

naval guns as compared with the work they were required to do, or merely an unconscious growth, certain it is that our ships of the beginning of this century—those which fought in the War of 1812—marked an era in the history of guns and armor. For the well-worn story of guns *versus* armor began, not when iron armor was introduced in 1850–60, not even in the War of 1812, but when guns were invented and mounted in ships.* The attention of naval men was first strongly drawn to the matter of guns and protection, however, in the War of 1812. The early builders of English and French ships of war had no very definite idea of how much tonnage should be assigned to guns and how much to armor—to thick and resisting sides; and, while English naval officers had certainly a sense of the value of thick sides, the keenness of that impression was immensely heightened by the results of the actions between their ships and ours.

Everywhere in naval history we see the records of lessons; some learned and some unlearned. Suppose it had been fully understood by Englishmen that good powder meant high velocity and good penetration, how long, if the conviction had borne proper fruit, could the Santissima Trinidad have lain under Collingwood's guns? This was perhaps understood; indeed, the history of the times enables us to *know* that it was understood, and understood best of all by naval officers, being corroborated, too, by the experiments of Robins, Hutton, and others. But the designs of ships and the guns and their equipment had not embodied the knowledge gained at so great expense. Naval officers, from causes which they could not perhaps control, had failed to press their views effectively, and their ships were not as good as they might have been.

The tactical features of the war-ships of the sail period were thus fairly well settled upon before the date of the Spanish Armada; their motive power was the sail, and their guns were nearly all carried on the broadside; but we shall look in vain for the close-hauled line of battle as early as this. The English vessels which fought with the Spanish Armada were handy craft, but the Admiral made no attempt to form a line of battle, and there is ground for believing that the close-hauled line was first formally adopted by the English in about 1685, through the influence of the Duke of York, afterwards James II. Thus more than a century elapsed between the fixation of the tactical features of ships and the formal adoption of the corre-

*A striking proof of this is the term *Old Ironsides*, given by the sailors of 1812 to the Constitution.

sponding line of battle. But it may be noted that during the sixty years immediately following the Spanish Armada, no great fleet actions were fought.

It has been stated that the tactical features of ships were fixed before 1550, but it was not meant to assert that no minor changes were made. The ships grew gradually in size, and whereas the first had never more than one covered gundeck, this number was gradually increased to two and three within the space of about 200 years. As the fighting ship—the line-of-battle ship—thus grew larger, there arose a disposition to exclude lighter ships—lighter in both guns and protection—from the line of battle; and we are told that Mathews' action in 1744 was the first in which fifty-gun ships were formally excluded from the line.

In the period between 1850 and 1860 great strides were made by the offense in the introduction of rifles and explosive shells; this was met by the defense by the application of iron armor; and the subsequent steps in the growth of these three elements have been very numerous, and are familiar to us all. The precise study of the relations between the offense and defense in naval warfare began at this time, and the full magnitude and importance of the question was perhaps for the first time realized by naval men. Such refinements as the forms of heads of projectiles, muzzle and remaining velocities, and qualities of temper of armor-plate and projectile, began to be studied assiduously. And let us not forget, in noting these additions to the curriculum, what changes they entail in the customs and habits of sea-officers. It is surprising and instructive, however, to find that neither the word *penetration* nor *velocity* occurs in the index of the Ordnance Instructions of our navy of date 1866, and a search has failed to discover them in the range tables given, or elsewhere in the text. Surely, in the light of the history of the ten years preceding the issue of this book; in view of the fact that Holley's excellent and exhaustive treatise on Ordnance and Armor had appeared four years before; and because the navy was still quivering under the spur of a great war, this is a pregnant instance of the so-called conservatism of naval officers.

It seems not a little extraordinary that, in view of the perfectly well-recognized contest between the offense and defense in land warfare, the recognition of that contest in sea warfare should have been so tardy. We are told that our frigates of 1812 were *disguised* seventy-fours; and in so far as their true power was disguised, we had

a tactical advantage over the British; but let it be remembered that this tactical gain was quite as much in protection as in guns. Our ideas must be definite and precise on this point: the concentration of great power in a few guns is claimed as an American idea, and as one which is valuable in warfare. But this principle, as ordinarily stated, is false. False in that it is stated as one of general application; and that it is not general admits of perfectly clear and rigid proof. The power of a gun should be such that it can overcome the structure to which it will be opposed in war. If this structure is a gun-carriage protected by an armored turret, the gun must give its projectile sufficient power to be able to destroy the carriage after penetrating the turret; if it is a gun's crew, behind a shield or behind only the unarmored side of a steel-built ship, the power required is only that necessary to get through this defense. Any greater power of projectile than that here indicated—the power necessary to overcome the defensive arrangements to which it will be opposed—is not only useless, it is harmful; because the problem comes to the naval tactician, when designing the ship, in this way: he has such a weight to put in guns and their equipment, and whether we regard the number of shells which will hit or their bursting effect, the result will be the same whether this weight is in few or many guns, provided the speed of serving the guns remains the same.

The table given shows at a glance the tactical values of the 5-inch and 10-inch guns. It has been supposed that these guns are similar, as is the case with our 5-inch and 10-inch guns, and therefore the weights for the 10-inch gun are found by multiplying those for the 5-inch by 2^3, or 8.

	Gun's weight.	Proj's weight.	Weight of bursting charge.
5-inch gun,	3 tons.	60 pounds.	2 pounds.
10 " "	24 "	480 "	16 "

The chance of hitting, when at sea with either of these guns, a ship twelve feet high situated at 1000 yards range, is about $\frac{1}{4}$. The Atlanta, if 60 tons were allotted to the guns alone of her main battery (her tonnage is 3189), could carry twenty 5-inch guns and $\frac{20}{8}$, or about three 10-inch guns. Thus, in firing at an enemy whose defenses either gun can penetrate, for any length of time, if each gun is served at the same speed—no matter what its weight and caliber is—the same weight of iron and bursting charge will be landed in the enemy's battery, whatever the caliber of the firing guns may be. But

the guns will not be served at the same speed; the lighter guns can be served more rapidly, and thus the ship should carry light guns if they can penetrate.

As has been asserted before, there is a certain relation of equality of power which should be maintained between the guns and protection of a ship. To say that they should be equal in power is pushing the theory too far—and equal in power at some definite and settled fighting distance, it must be remembered; but that we should have always an eye to this while guiding the distribution of guns and armor according to existing and approved models, is not saying too much. It was discovered, after the War of 1812, that our ships threw a greater weight of metal at a broadside than the English ships, and this has been adopted, and repeated again and again, by writers on naval subjects as a principal cause of the brilliant victories of that war. But it must not be forgotten that our ships were better protected than the English ships; they were larger and their sides were much thicker.

A consideration of the changes in tactical features between the Constitution, built in 1797, and the Atlanta, built in 1883—a century apart nearly—is very striking. The table below gives the batteries of the two ships, the one given for the Constitution being that carried when she fought the Guerrière.

	Constitution.	Atlanta.
Guns carried,	{ 32 long 24s. 22 short 32s.	6 6-inch B. L. R. 2 8- " "
	—	—
Number of guns,	54	8
Weight of broadside,	684 pounds.	800 pounds.

With her long 24s, the Constitution could probably just about penetrate her own side—some twenty inches of oak—at 1000 yards range; to penetrate with the short 32s, she would have to approach nearer. This ship, then, is completely protected against her own fire at ranges greater than 1000 yards; she is impenetrable to it at greater range, and this extends, it should be noted, to the ship's life——her buoyancy and stability—and to the lives of her crew. The Atlanta's 6-inch guns can penetrate, at 1000 yards, about 11 inches of iron—that is, a thickness twenty-two times that of her side at the water line; and the 8-inch guns, at the same range, can penetrate about 14 inches of iron. And, it may be observed, the ⅝-inch steel of the Atlanta has just about the same resisting power as the 20-inch

oak of the Constitution. Thus, while the defensive power of the hulls alone is the same, the later ship has a battery which has gained penetrative power in about the ratio of 25 to 1. Nor will the balance be materially altered by including in the discussion the other defensive arrangements of the Atlanta. Her under-water protective deck may throw off a 6-inch projectile fired at 1000 yards range, but it hardly would an 8-inch; and, so far as the protection afforded the gun's-crews by the shields goes, there is nothing gained, as these are intended only to keep out quick-fire projectiles. If we examine the danger of raking fire to the two ships, the showing of the protection of the Atlanta will be even worse, because, as the under-water deck does not extend to her ends, she has no protection here but what the thin plating of her side affords. It is true, then, that whereas the protection afforded to the lives of the gun's-crews of the Atlanta and Constitution is of the same resisting power, the power of the main battery to penetrate is in the ratio of 25 to 1 in favor of the later ship. It follows from this, since the men who will fight the ships are much the same, that the Atlanta's fighting range is greater than the Constitution's.

In the study of the subject of Gun Tactics as Discoverable from Types of War-Ships, the difficulties we encounter as regards our own times are very different from those which pertain to earlier periods. The student of naval history finds few clear and full accounts of the material used, in the various works to which he ordinarily has access; and the difficulties arising from the absence of much that is important to form a clear picture of the war-ships and crews of only a century ago, become very great when we go further back, to the time of the genesis of the sailing war-ship.

On the other hand, our difficulties are the opposite as regards our own times. There were, perhaps, not more differences in the types of the ships which formed the great fleet England got together last summer to celebrate the Queen's jubilee year, than were present when Howard, Drake, John Hawkins, and, as so charmingly and graphically told by Charles Kingsley in *Westward Ho*, Amyas Leigh and his crew of Biddeford men, went out to attack the Invincible Armada of Spain. But the types of later date are all known to us—our embarrassments arise from the mass of material before us. There were, I think, nearly as many types then as now; but we have them now all described, and commented on—the comment

exhibiting every shade of difference of opinion. The story of the growth of late types is told most accurately and fully, and in such a way as to be accessible to all. But the immense mass of information and of conflicting opinion, and the want of any test by which to try theories that we may form, makes the task of discovering tactical types a difficult one.

Our discussion must, for the present, be strictly limited to battle ships, to what were formerly called line-of-battle ships, that is, vessels of great power which were intended to fight in fleets. These vessels were less useful, it must be remembered, for many purposes in war than were the frigates. They were as large as the seamen of the day thought could be safely and economically used, because an increase in size means an increase in fighting power, both of offense and defense. But, in passing to the limit of size, so far as safety, with some regard to convenience, is concerned, a certain degree of handiness and general efficiency was sacrificed. No reason could justify the building the line-of-battle ship of old, except the necessity imposed by possible enemies possessing these craft; just as the huge ironclads of to-day must be maintained by nations which would retain their sea power. By thus formally separating battle-ships from other war ships, a certain difference between them is implied. Let us see if this difference exists.

It hardly existed in the sail period. The frigate was faster, more weatherly, and more handy than the ship of the line. And these qualities gave her important military advantages—she could lie closer in to a blockaded port, whether the wind were blowing on shore or the reverse; but her protection and the fire of her guns, whether considered as to the arc of the horizon it commanded or as to its weight on different arcs, was the same in kind—it differed in degree only. Frigates' sides were not mere paper covering, while battle-ships carried strongly resisting armor, as is now the case. The tactical differences separating war-ships of different classes are sharper now than formerly; and, indeed, are sufficiently sharp to warrant the study of each class separately.

The sailing line-of-battle ship—of which the 74-gun ship is the type—took on clearly the tactical features which they wore for 200 years, in the last half of the seventeenth century; between the beginning of the great Dutch-English wars and the time of Benbow—that gallant seaman of the old school. The first two-decked war-ships—or 74, according to the nomenclature finally adopted—built in Eng-

land was the Great Harry, laid down by order of Henry VII, about the year 1500. Thus the 74, the battle-ship of the sail period, took at least a century and a half to mature. And you will recollect that the 50-gun ship still often fought in the line until 1744; nearly 250 years after some distinctive features of the two-decked 74-gun ship were adopted. How then can we hope by an examination of the history of navies for the last forty or fifty years to know what the true battle-ship is and how she will fight? Yet it may be that we can determine with some degree of certainty; for it appears that there is already a consensus of opinion upon many important points. The agreement as to type of ship carries with it agreement as to fighting tactics.

To put myself on record before we invade the great mass of facts and opinions which we shall encounter, I wish to express the view that the usual battle-ship—the type-ship—will be of about 6500 tons, will be a ram, and will have nearly equal all-round fire from rifled guns of about 12-inch caliber. The distribution of armor is the matter which involves the greatest difficulty. My preference is for a distribution of armor similar to that adopted in the Italian ships Italia, Lepanto, and in the three projected ships of the Re Umberto class. That is, for the abolition of all hull armor, and the reliance for the protection of the ship's buoyancy and stability against shot holes at the water-line upon *internal* protection, so called—that is, underwater decks and the minute cellular subdivision of the hull at the water-line. Whatever weight of armor is available may be used to cover the ammunition hoists, the smoke-pipes, steering gear, conning tower, and the mechanism and crews of the guns.

Ships such as the English Conqueror, the Brazilian Riachuelo, our own battle-ship, and the French Duguesclin, are vessels of about the type here contemplated. It would be curious, however, to speculate as to whether, in our battle-ships, we shall adhere to our policy of building vessels of each type a little heavier than those of other nations, as was the case with our frigates and sloops of 1812, our line-of-battle ships built just after that date, and with the classes of new steel vessels just built.

There are some points about the four vessels just named which appear worthy of note.

First.—They all carry batteries, of no inconsiderable power, of guns lighter than their heavy guns—that is, a number of guns of about 6-inch caliber. This feature has been of recent growth in English

battle-ships, while those of France have had it from the first. The heavier guns, again, are of greater absolute power than the guns of earlier ships; that is, the power of the guns has been growing. This growth has, perhaps, reached its limit in the B. L. 110-ton guns of the English ship Benbow and the Italian ships Lepanto and Italia. The wave is now receding, and it is doubtful if many naval officers are in favor of larger guns than those of 12-inch bore (about 45 tons weight), except in a few ships of great size and power. The term *absolute* power has here been used to signify the actual power of a gun, rather than its power relatively to the ship's displacement, or to the power of the protection afforded it.

Second.—The armor which protects the buoyancy and stability of these vessels—their water-line belt—is usually of about the same thickness as that which protects the mechanism of the heavier guns. The Duguesclin exhibits the most marked departure from this rule; her belt armor is 25 per cent thicker than the barbette armor (ten and eight inches).

Third.—The distance at which the heavy guns of these ships can penetrate the water-line belt of their own ship is about 4000 yards. This, of course, is for normal impact, and assumes—what is very nearly true—that the muzzle velocities of all the guns is 1800 f. s. In view of the oblique impact which will rule in war, this range may be materially shortened. It is meant here to take into account obliquity arising from the angle of fall of projectiles and from the accidents of flight. When we add that arising from the enemy's skillful maintenance of large angles of presentment, the range may be further shortened.

Fourth.—The lighter guns of the main battery have not quite enough power to penetrate either the water-line belt or the armor protecting the mechanism of the heavy guns, even when the range is very short.

Fifth.—The crews of the heavy guns of the Duguesclin are protected only by the gun-shields—that is, against the fire of secondary guns only. The crews of the smaller guns of the main battery, and the mechanism of these guns, are wholly unprotected, except by shields, in all four ships.

This last is the point where all attempt to strike a balance between the offense and defense seems to be abandoned. It looks as if the 6-inch guns were thrown in without much reflection. Let us, however, dispose of the simpler question first; that of barbette *versus*

complete turrets. The Duguesclin has barbettes, and the other ships have the complete turrets. The advantage claimed for the barbette, outside of the saving of weight, is that the crew cannot see well in a complete turret—at times will be ignorant of where the target is. The crews of barbette guns, it may be added, are always protected against secondary fire by shields. But, throwing the gun's crew out of consideration entirely, why is the mechanism of the gun protected and the gun itself unprotected? It is not likely that a 12-inch gun would survive a blow from a heavy gun. The French, it may be added, have adopted barbettes almost exclusively; the Italians use them in their large ships, and the English adopted them in the Admiral class, of recent date, but in their latest ships, the Nile and Trafalgar, have returned to complete turrets.

In the four ships now under consideration—all built between 1882 and 1888—there is no protection whatever afforded either gun or crew in the light main battery guns, against the fire of similar guns. And, it may be added, there is not one main battery gun of lighter power than the heaviest gun of that battery, in any French or English ship built since 1880, of which the crew is protected. There are several ships built just before 1880 in which these guns are protected; as the Trident class in France, and the Temeraire and Rupert in England. And, if we go back to the earlier ironclad ships, we find that many of the guns'-crews are protected.

It appears that the tactical rule which is thus recognized in these four ships of recent design may be challenged. Why are these guns better than an equal weight of quick-fire guns of lighter caliber? From these latter a greater weight of shell and of bursting charge may be delivered in a given time; and they would secure, in the absence of armor protection, the protection which is gained by scattering the weight in a number of guns. As far as penetration goes, the two kinds of battery are the same, if we assume, as we surely may as a rule of general application, that ships are intended to fight their likes. We can conceive, however, of many cases in war in which the battery of 6-inch guns would be better than the numerous quick-fire guns of equal total weight; as, for instance, in a battle with an ironclad of inferior power, or in shelling defensive works on shore.

Sixth.—As to the range at which battles will be fought. We must accustom ourselves, in thinking of guns and protection, to further complicate this difficult subject by carrying in our mind the *range*

at which we desire protection. The Conqueror and our battle-ship can pierce her twin in a vital part, with normal impact, at 4000 yards range; and, in view of the very remote probability of a shot striking just right at this range, we may conclude that no material danger will usually be incurred outside of 2000 yards. At this range, shots which strike at any inclination to the plane of the armor, greater than 45°, will penetrate. Will 2000 yards, then, be the fighting range? Or, to put a more direct question, have those who controlled the designs of these ships assumed that battle-ships will fight at 2000 yards? And here we are met by an apparent absurdity. If the range of the gun contest will usually be less than 2000 yards, nearly every shot that strikes will penetrate, and the armor be much worse than useless. Why, then, have armor at all?

But if the combatant ships are commanded by skillful officers, one will seek close range and one will try to avoid it. The ship with skillful gunners will hold off at a range where her guns will penetrate and where yet it requires some skill to hit; and, when she has gained some advantage, will approach nearer and trust to the rapidity and accuracy of her fire to drive the enemy from the guns. One ship cannot abandon her armor unless the other one does also.

Seventh.—Is the rule that the ship's stability and buoyancy should be protected by about the same thickness of armor as the fighting power of the heavy guns a sound one? It is very difficult to answer this question; particularly as, after all, the protection is afforded often to a part only of the gun's fighting power. The ship, however, we may say, is built to carry the heavy guns about; and if the gun is destroyed, nearly as much harm is done as though the ship were destroyed. Such an argument would justify an approach to equality in the two thicknesses. The present disposition is to make the water-line belt a little the thickest, as the following table will show. In this table, B. L. guns are assumed to have a velocity of 1800 f. s.; M. L. one of 1400; and to state thickness of armor in equivalent measure, compound and steel armor has been increased by 50 per cent of itself.

English.	Penetration of Heaviest Guns at 2000 yards. Inches.	Water-Line Armor. Inches.	Thickest Gun Armor. Inches.	French.	Penetration of Heaviest Guns at 2000 yards. Inches.	Water-Line Armor. Inches.	Thickest Gun Armor. Inches.
Agamemnon	12.5	18	16	Amiral Baudin....	23.1	32.4	24.7
Ajax....	12.5	18	16	Amiral Duperré...	18.7	21.6	12
Anson..................	19	27	21	Bayard...............	13.3	9.9	7.9
Benbow................	22.7	27	21	Brennus..............	18.7	26.0	23.6
Collingwood........	17	27	21	Charles Martel....	18.7	26.0	23.6
Camperdown.......	19	27	21	Colbert...............	14.9	8.6	6.3
Colossus..............	17	27	24	Courbet..............	18.7	15	9.5
Conqueror...........	17	18	18	Devastation........	18.7	15	9.5
Hero.....................	17	18	18	Formidable..........	23.1	32.4	24.7
Devastation.........	12.5	12	14	Friedland....	14.9	7.9	7
Dreadnought........	12.5	14	14	Furieux...............	18.7	29.4	26.6
Edinburgh...........	17	27	24	Hoche.................	18.7	26.6	23.6
Howe.....................	19	27	17.5	La Galissonnière.	13.3	5.9	4.8
Inflexible	16	24	25.5	Magenta.............	18.7	26.6	23.6
Neptune................	12.5	12	13	Marceau	18.7	26.6	23.6
Nile	19	30	27	Marengo	14.9	5.9	4.8
Renown	22.7	27	27	Neptune	18.7	26.6	23.6
Rodney..................	19	27	17.5	Ocean.	14.9	5.9	4.8
Sans Pareil	22.7	27	27	Redoutable...	14.9	14.0	9.5
Temeraire	12	11	10	Richelieu...........	14.9	5.9	4.8
Thunderer............	12.5	12	14	Suffren...............	14.9	5.9	4.8
Trafalgar	19.0	30	27	Vauban..............	13.2	9.9	12.0

English.

Sum of first column, 380.1
" second " 487
" third " 433.5

French.

Sum of first column, 377.3
" second " 384
" third " 315.3

We have then,

$$\frac{\text{Water-line armor}}{\text{Gun armor}} = \frac{487}{433.5} = 1.12 \qquad \text{English.}$$

$$\frac{\text{Water-line armor}}{\text{Gun armor}} = \frac{384}{315.3} = 1.22 \qquad \text{French.}$$

From these tables it appears that both the French and English think that the mechanism of the heavy guns of a ship should be protected by nearly as great a thickness of armor as the water-line. The barbette towers, which appear in nearly all late French battle-ships, show how little protection they think it necessary to give the crews. The English give much more weight to this feature. The crews of the heavy guns are protected in all their battle-ships except in the Admiral class—the Collingwood, Benbow, Anson, etc. The Temeraire is the only other ship which has barbettes, but her guns are mounted

on the disappearing principle, and thus the crew are protected when loading. Another interesting conclusion may be reached by dividing the sum of the first column by the sum of the third; that is, divide the average penetration at 2000 yards by the average thickness of iron protecting the gun.

$$\frac{\text{Penetration at 2000 yds.}}{\text{Gun's armor}} = \frac{380.1}{433.5} = .88 \qquad \text{English.}$$

$$\frac{\text{Penetration at 2000 yds.}}{\text{Gun's armor}} = \frac{377.3}{315.3} = 1.20 \qquad \text{French.}$$

The difference in the practice of the two nations is even more noticeable here than in the comparison first made. The French give more to the offense than do the English—the mechanism of French guns is not so well protected as is the English.

In our examination of some types of ironclads of recent construction, we have, however, passed over an important era in the history of the development of war ships and tactics—that of the disappearance of the seventy-four and the genesis of the ironclad. To cover this period we must return to the year 1850, and to the time immediately following our Civil War. Already, as early as 1841, a board, consisting of Commodores Perry and Stewart and two army officers, had been ordered to report upon Stevens' ironclad battery, proposed in the year 1816 for the defense of harbors; the proposal to protect what we call sea-going battle-ships was not made until about half a century later, as we all know.

The death-knell of the wooden 74-gun ship—the sea-going battle-ship—was sounded when the Wabash class of frigates appeared in this country in 1855. Other ships carrying numerous guns on a single gun-deck had appeared before the Wabash, notably the Imperatrice Eugenie, built in France in 1854, and measuring 3600 tons. But this ship was far surpassed in battery power by the Wabash, as were also all 74s then afloat, both steam and sailing. The Wabash class, until they were displaced by ironclads—and note how arbitrary is the naming of these types—were the battle-ships of the world. The English built frigates even larger—the Orlando and the Mersey—and the impression being strongly fixed that ironclads could not be made sea-going, these heavy frigates were really becoming the ships-of-the-line. The English and French went on for a short time building the old type of battle-ship—vessels carrying guns on two or three gun-decks—and converting those in service into steamers; but none

of these vessels were the equal of the Wabash class in fighting power. The Duke of Wellington, one of England's later steam ships-of-the-line, was a larger ship than the Wabash, but she was probably unequal to her in fighting power.

It is curious and instructive to speculate as to the tactical differences exhibited by these heavy frigates and their probable opponents in war, the so-called ship of the line, and to try to determine what the growth of tactical ideas would have been if the ironclad had not stepped in and cut the Gordian knot. The difference between the heavy ships which we built and the liners built in Europe at about the same time, was, in the main, that we put the guns on a single covered deck, while in Europe they put them on two or three. It would be hard to discover any sufficient tactical distinction between the two: and our departure probably arose more from a desire to make the ship's lines easy than from any consideration as to the disposition of the guns. The movement in the direction of long narrow ships, for both trade and war, which culminated a few years since, took its growth in the craft built in this country in the early part of this century.

The ironclads came along rapidly, however. Stimulated by the results of the engagement at Kinburn in 1854, the Gloire, Invincible, Normandie, and Couronne were laid down in France in 1858; and in the following year the English laid down the Warrior and Black Prince. These ships, in their turn, pushed the heavy wooden frigates out, and succeeded, for a short time, to the position of first-class sea-going battle-ships. They were opposed by many officers, and their sea-going qualities, or rather sea-*keeping* qualities, were affirmed to be inferior. But as we look back now, we see that they were, in their short day, the most powerful war-ships afloat. They were very large ships for their time, being of 9210 tons displacement. And here, at the very start of the race between England and France in the development of the new battle-ship, we see the evidence of the boldness and energy which has marked England's course at every step. The heaviest steam line-of-battle ships of the day were of about 5500 tons; the English laid down two ironclads of 9200 tons, and the French four of only 5500. The defense of the English ships differed from that of the French. It consisted of a rectangular patch of iron armor extending about two-fifths only of the ship's length, and vertically from two feet below the water-line to the upper deck beams; this patch was from six to four and one-half inches thick. The French ships were armored with a rectangular patch of armor

extending from two feet below the water-line to the upper deck beams, throughout the whole length of the ship. It is from four and three-quarter inches to three inches thick.* The guns carried by the English ships were twelve one-hundred-pounder Armstrong rifles and twenty-eight sixty-eight-pounder S. B.; those of the French ships were thirty-six fifty-pounder rifles. The former could penetrate their own thickest armor with their rifles at about 2500 yards range; the latter could do the same at about the same distance. Thus, so far as the measure selected between the offense and defense in these ships goes, they are equal; but in absolute power the English ships are superior, as of course we should expect them to be from their greater tonnage.

The engagement between the Monitor and Merrimac in Hampton Roads in March, 1862, gave the next sharp note of the coming changes. Neither of these vessels was sea-going and sea-keeping, as we now readily admit; but Ericsson's Monitor perhaps did more to change tactical types and naval tactics than any other type-ship that ever appeared. And to the credit of naval officers be it noted, these extraordinary crafts were well received by them. First, by the board consisting of Captains Joseph Smith, Hiram Paulding, and Charles H. Davis, who, in September of 1861, in passing upon a number of designs placed before them by the Secretary of the Navy, recommended Ericsson's plan as "novel, but . . . based upon a plan which will render the battery shot and shell proof"; and afterwards, in actual service, by John L. Worden, John Rodgers, Admirals Dahlgren and Porter, and others.

The tactical qualities first embodied afloat in the Monitor are (1) a fire which is equal all around, however we may measure it, whether as to penetration, weight of projectiles thrown in a given time, or chance of hitting; and (2) equal all-round protection. The latter quality is, at first sight, possessed by all the old sailing vessels. But from the greater danger incurred as fire was received from before or abaft the beam, these vessels were, defensively speaking, far from being independent of the presentment angle.

The absolute power of the offense and defense of the Monitor, as compared with ships just completed, was very great. Here is a vessel of 1300 tons—not much larger than the Macedonian or Java—carrying two guns of 11-inch caliber, throwing a shot of 165 pounds

* The features here seen—the *bunching* armor on English ships and *diffusing* it in French ships—are visible in ships of the most recent date.

weight. Her guns and guns'-crews were protected by 11 inches of iron, and the ship's life by 5 inches of iron and nearly three feet of wood. She was practically impenetrable to her own fire; and, by virtue of the form of her turret, round shot of any size would bound away harmlessly from all but about one half the cross-section of her turret.

Between the Gloire and the first Monitor, the power of the defense is more than doubled (4.7 inches to 11 inches); and the offense has increased in nearly the same ratio (50-pdr. M. L. R. to 11-inch (140-pdr.) S. B.).

The increasing power of rifled guns soon overcame the balance shown against the offense in the Monitor, and has accelerated the movement already begun, to withdraw armor from the less vital parts of ships and mass it wherever important to the ship's fighting power. In this latter direction—towards protecting very strongly what are held to be the vital parts of ships—naval construction has been driven too far by the gun. Of late years, naval officers have expressed themselves as opposed to this tendency.

These two tactical qualities, equal all-round offense and defense, are the most characteristic of the Monitor. They may be summed up by saying that she was indifferent as to the angle of presentment; a matter of vast importance when considering her gun tactics, whether in single or fleet actions. She is also a most interesting type from the fact that she was very nearly indestructible by her own fire. Stating the ratio between the penetration at 2000 yards and the gun's armor, as has already been done for twenty-two of the largest recent battle-ships of England and France, we have:

For the Warrior:

$$\frac{\text{Penetration at 2000 yards}}{\text{Gun's armor}} = \frac{7}{4.5} = 1.6;$$

For the Monitor:

$$\frac{\text{Penetration at 2000 yards}}{\text{Gun's armor}} = \frac{3}{11} = 0.28.$$

There is some uncertainty involved in the last ratio, owing to the difficulty of stating the power of penetration of the S. B. guns which the Monitor carried, but it suffices to show through how wide limits the ratio of the power of the offense to the defense has varied.

The claim often brought forward for the Monitor class of vessels—that they offer a small target to gun-fire—is, perhaps, not wholly admissible. They have concentrated the gun-power in a small space,

but this space is not much smaller than the same two guns would occupy under any circumstances. It is true that, from the curved form of turrets, the part of the cross-section where shot will bite is much smaller (about one half) than would be the case with flat armor. But this reduction in size of the target is the only one which the Monitor type secures, for the parts of the ship which contain the other things necessary to fighting power are of the same size. It is a mistake to claim the low free-board of the Monitors as a military advantage. This matter has a peculiar interest just now, when so many battle-ships which are more or less of the Monitor type have their ends built up to increase their margin of buoyancy and stability, and give proper and healthful quarters to their ship's companies, as, for instance, the Victoria, and all the large Italian ironclads. The feature is, indeed, almost universal in European battle-ships of the Monitor type.

The ships just mentioned—the Victoria and the large Italian ironclads—together with such ships as the English Nile and Trafalgar, the French Marceau, Hoche, and others of their class, representing the furthest advance in fighting power, are little more than Monitors, with their turrets lifted higher out of water, and with light superstructures at their ends for the berthing of the crew and for mounting lighter and unprotected guns. This type, which first showed itself in the Monitor, has become, it would appear, the battle-ship of all nations.

To run through the history of the development of ironclad vessels is the work of a few minutes. And note the advent of a sharp line of demarcation between armored and unarmored vessels. We have now, it is true, besides armored battle-ships, armored cruisers, armored gunboats, and armored torpedo-boats—a fleet without unarmored vessels. But, though a few of these latter are in existence, the rule is to leave many war-ships unarmored; we are familiar with such terms as partially protected and unprotected cruisers, and most gunboats and torpedo-boats are entirely unprotected, in the modern sense of the term. Will this armored fleet prevail; will the mixed rule of tactics be adopted—will there be both armored and unarmored classes of vessels, or will the armor of the battle-ships gradually shrink up and be discarded?

Such are the questions which naval officers, not by the chance utterance of hastily formed opinion, but by the steady pressure which settled conviction makes possible, must decide. Why should

recently laid down ships like the Atlanta and Boston, and the four English ships of the Leander class, all of about 3500 tons displacement, while unprotected except by an underwater deck extending through a part of their length and covering boilers, engines, and magazines, carry guns of 6-inch and 8-inch caliber; and the four of the Mersey type, and our own ship Charleston, of practically the same displacement, have heavy protective decks extending throughout their length, and carry guns of from 9.2-inch to 6-inch caliber? The ships last named are more recent by two or three years than the others, and may represent the movement in the direction of better protection which is here urged.

We shall not find any of the ships just named among lists of armored vessels—they are never so classed. But if we mount the scale of displacement tonnage from the 3550 tons of the Mersey type to the 5000 tons of the seven English ships of the Orlando class, we find, with an increase of gun-caliber of only from 8 inches to 9.2 inches, an increase of armor from the 2-inch to 3-inch protective deck to a 10-inch water-line belt extending through a part of the ship's length, while the rest is protected by an underwater deck. The ratio of the defense of the Mersey to that of the Orlando is about $\frac{1}{2}$ (the ratio of horizontal thickness for a slope of protective deck of 28°); while that of their offense is (estimating for the heaviest guns only) $\frac{8}{9.2}$. One or the other of these types must disappear, or we must agree upon a compromise. They cannot both be well considered.

To go back, then, to the question of ironclad development since the time of the Monitor, we may say that it has consisted in an increase in size and fighting power of the unit. The Monitor measured 1300 tons, cost $275,000, and was built in 100 days; the Nile and Trafalgar, the last additions to the battle-ships of England, measure 12,000 tons, cost $5,000,000, and will not be ready to go into battle five years after their original design. We may well doubt whether such a showing is, in all respects, an improvement. The ratio of the power of offense between the Monitor and the Nile is, at the guns' muzzles,

$$\frac{mv^2}{m'v'^2} = \frac{165\,(1200)^2}{950\,(2000)^2} = \frac{1}{16}\text{, about;}$$

while the ratio of power of defense at the water-line is about

$$\frac{5}{30} = \frac{1}{6};$$

over the guns it is

$$\frac{8 \text{ or } 9}{27} = \frac{1}{3}.$$

The power of the gun has increased more than that of the armor. And, it must be noted, the armor has shrunk up in the parts taken, at the expense of leaving other parts unprotected. This growth has gone too far, if navy officers are to be believed.

If we examine the history of types of battle-ships in the British navy, we recognize that they have narrowed down to one type—the monitor. And it is plain also that the two distinctive tactical qualities already asserted to belong to the monitors—equal all-round fire and protection—are possessed by these vessels.

The tactical results which follow, if it be true that the Monitor has imprinted her qualities upon modern battle-ships, are most important. So far as gun tactics then go, the gun asks nothing with regard to the presentment angle, and we need inquire only what range the gun will prefer. For good effect, as we know, this should be less than the dangerous range,* so far as the chance of hitting goes. We are then met with the further question, will the shots which hit usually penetrate at this range? The examination we have already given to the ratio of the power of offense and defense in forty-four large and recently constructed French and English battle-ships, enables us to assert that the guns, as a rule, lack power to penetrate the thickest armor beyond 2000 yards. This latter range, then, which has been indicated as the opening range, from consideration of the chance of hitting, receives support as such from considerations of penetrative effect. This near coincidence can be no more than an accident, but it would be curious to speculate upon whether we should admit, as a rule of ship design, that the guns should be able to overcome the armor at less ranges than the opening range. And, if we admit such a rule for battle-ships, should we extend it to cruisers and other smaller vessels? The opening range, depending as it does upon elements which are the same for all high-power guns, is the same for guns of all calibers.

There is little use in attempting to describe all the various minor changes through which English battle-ships went before the Monitor was recognized as the true type, without the aid of full and complete

* The range within which we need not know the distance; that for which the whole range is dangerous space. With targets twelve feet high it is about 1100 yards.

drawings; and the attempt will not be made here. The guns were continually increased in power, as was also the armor; but the latter did not move so rapidly. This led the ship designers and constructors in two directions: (1) toward greater displacements, and (2) toward bunching the weight of armor on vital parts. But naval officers oppose a too great extension in either of these directions; and the result is a compromise which, while it satisfies neither class, may yet embody much that is wise in the views of both.

The first English battle-ships were purely of the broadside type. Large rectangular patches of rather thin (according to present notions) armor covered considerable part of the ship's broadside. This armor covered the water-line or the guns' crews, or both; but, it should be noted, the first movement, while the lessons of the Crimean War were still fresh, was in the direction of covering both guns and guns' crews. In 1866, the Monarch, the first turret ship built in England, was laid down. She was followed by the Thunderer and Devastation in 1869, and the Dreadnought in 1870. No purely broadside ship has been built since this date. The Sultan, Shannon, and Alexandra, usually classed as broadside battle-ships, were laid down in 1873; but in their tactical features, equal all-round fire and protection, they approach the Monitor type. Then, in 1874, the Nelson and Northampton, also classed as broadside ships, were laid down. The same remark applies to them.

The difference between the protection of British and French ships may be broadly stated to be that, whereas the latter have generally a complete water-line belt, with the mechanism of the heavy guns protected, the former diminish the length of the belt, and apply the weight thus saved to an increase in thickness of the part of the belt remaining, and to covering the crews of heavy guns.

The French battle-ship is distinctly a barbette ship, carrying her heavy guns high above the water, and protected throughout the whole water-line by an armor belt. This type appeared as early as 1867, in the Alma class; the last broadside ships being the Provence class, of date 1863.

Before quitting the history of battle-ships, I wish to say a word as to the introduction of underwater protective decks. Vessels whose official classification is *armored*, as well as those classed *unarmored*, often have these decks. The latest of the large Italian ironclads are protected throughout their water-line by a protective deck three and a half inches thick; and all recent English battle-ships are so

protected for a part of their length. The French adhere, however, to their complete belt of vertical water-line armor.

The underwater deck was first introduced in the nine English ships of the Comus class (sometimes called the C class), laid down in 1876. The decks in these vessels are only one and a half inch thick, and cover only the engines, boilers and magazines. Protective decks were of slow adoption, and are not much used in the French navy. The French laid down the fine cruisers of the La Perouse class of 2300 tons in 1873-6, without an ounce of protection, except gun shields; the Aréthuse and Dubourdieu, of 3400 tons, in 1883, also without protection; and only when we come to the Sfax, Tage, and Amiral Cécile, of from 5000 to 7000 tons displacement, and laid down in 1883-5, do we find them adopting protective decks. As regards the use of underwater decks as the water-line protection in battle-ships, it has been already remarked that the French refuse entirely to trust to it; that the Italians have frankly adopted it in their latest and most powerful vessels; and that the English use it always for water-line protection at the ends of ships. The English used it first in the Inflexible, laid down in 1874.

As has been mentioned, it may be that much which now marks sharply the division between armored and unarmored vessels will disappear—that, in short, the value of the ratio

$$\frac{\text{Power of offense}}{\text{Power of defense}},$$

at a fixed range, will be approximately the same for vessels of all classes. First among the changes which may bring this similarity about is the adoption, by war-ships of nearly every class, of underwater protective decks.

The history of the development of unarmored vessels since about the year 1850 offers little of interest not already noticed. The Wabash class of ships—of 4700 tons displacement—is the vanishing point of all the old types. She was a *frigate*, so-called, and the French and English continued to build battle-ships on two decks for years after her appearance. But the Wabash was a battle-ship, and would unquestionably have fought in the line if she had ever been in battle on the high seas. Her nearest representatives are now the so-called *armored cruisers;* such as our 6600-ton vessel of that class, the Aurora class, of 5000 tons, in England, and in France, the Sfax and Amiral Cécile. And, it may occur to us, are not these perhaps the future battle-ships? They are usually armored turret or barbette

ships, of rather less gun-power and protection than the vessels classed as battle-ships, and with more speed and coal endurance.

But although the old type of frigate—the eyes of the fleet, as Nelson called them—was lost in the Wabash, it was not lost irrevocably. It was much confused by the redundancy of types which sprung up during our Civil War. But the frigate of old is still extant, in vessels of from 1500 to 3000 tons displacement; like our Atlanta and Boston, and the Comus, Leander, and Mersey classes in England. The last two classes, of 3700 and 3500 tons, are probably the extreme limit to which the frigate class should be pushed.

Let us now, while occupied with this subject, inquire what military qualities the frigate must possess. The history of the sail period—a period of 300 years, prolific in great maritime wars—shows that they must be able to accompany the fleet; must, indeed, have speed, sea-keeping and sea-going qualities in excess of those of the battle-ships; and must be able to patrol and guard trade routes, or to convoy along them. Their power of offense and defense must be made subordinate to these requisites. As regards the ratio of the power of their offense to that of their defense, history teaches nothing but what common-sense will equally assert—that there is no reason why this should depart widely from that usual in battle-ships. Frigates and ships of the line fought at the same range in former times; and frigates did not—never did—attempt to fight battle-ships; nor did sloops or brigs fight frigates. The vessels of the smaller class, if overhauled, would fire a gun for the honor of the flag and then surrender.

Two 10-inch B. L. R. have lately been mounted in the paper-sided Esmeralda (2920 tons.) For what? We are told that it is so that she may be able to give a good account of an ironclad, if she encounters one; and Mr. Brassey says less pointedly, in his Naval Annual for 1886, that it is the development of Mr. Rennie's idea of carrying very powerful guns in small and swift vessels. The Italians have reproduced some of the tactical features of the Esmeralda in Giovanni, Vesuvio, Etna, Stromboli, and Fieramosca; the Japanese in the Naniwa-Kan and Takachi-Ho; and we have some of her features—but not the one here discussed, of very heavy unprotected guns on a small displacement—in the Charleston.

The unarmored 10-inch guns of the Esmeralda and her class, and the armored guns of the same caliber carried by other ships, cannot endure together. If it is right that guns of this caliber should go to

sea unprotected, they should go in smaller and less expensive vessels than the Esmeralda. In the sudden stress of war it might be well to build quickly five or six small vessels, each to carry a 10-inch unprotected gun; and several such craft might overcome an iron-clad of large size. But there can be no equilibrium of type as long as 10-inch guns, both protected and unprotected, are at sea. It may be, as some contend, that armor protection will be disused; and though the Esmeralda may contribute to this end, she herself will pass away when that end is reached.

The following table gives the weights of the main batteries of a number of unarmored and armored ships (the weights of the guns have been multiplied by two, in order to allow approximately for the carriages). The Esmeralda, it is curious to observe, has a very slender secondary battery.

Unarmored.

Name.	Displacement.	Main Battery.	Weight. Tons.	Per cent of Displacement in Battery.
Esmeralda, . . .	2900	2 10″ and 6 6″	160	5.5
Nani-wa, ...	3600	2 10″ and 6 6″	172	4.7
Charleston, . . .	3700	2 8″ and 6 6″	116	3.1
Atlanta, ...	3200	2 8″ and 6 6″	116	3.6
Mersey, ...	3500	2 8″ and 10 6″	156	4.5
Canada, ...	2400	10 6″	100	4.2
Rapid, ...	1400	2 6″ and 10 5″	60	4.3
Mariner, ...	1000	8 5″	32	3.2
Armored.				
U. S. Battle-Ship, .	6300	2 12″ and 6 6″	240	3.8
U. S. Arm. Cruiser,	6700	4 10″ and 6 6″	252	3.8
Aurora, ...	5000	2 9.2″ and 10 6″	184	3.7
Conqueror, . . .	6200	2 12″ and 4 6″	212	3.4
Warspite, . . .	7400	4 9.2″ and 6 6″	204	2.8
Anson, ...	10,000	4 13.5″ and 6 6″	596	6.0
Trafalgar, ...	12,000	4 13.5″ and 8 5″	568	4.7

The fraction of the weights of these ships occupied by guns and their carriages is small—will perhaps be surprisingly so to many, but all recent ships are much the same in this respect. The average of the eight unarmored ships taken is 4.1, and that of the seven armored ones 4. Thus we may say that no settled rule, as to the difference

of weights allowed to guns in armored and unarmored vessels, has been discovered. It is worth while to observe, however, that there is a sensible difference in comparing the caliber of the heaviest guns carried with the displacement, as between the Nani-wa and Charleston with the Esmeralda. The latter vessel has excited a great deal of comment; but the other two ships are far from being like her as to their main batteries—the matter in question here.

Besides the Wabash class, we designed and built in this country, at about the same time, two other classes of vessels which were really more nearly frigates—though they carried their guns on an uncovered deck—than were the Wabash class. I refer to the Hartford class, of 3000 tons, and the Iroquois class, of 1500 tons. Then, in the fever and pressure caused by the Confederate cruisers—a feature of war by no means new or original—were built several classes of vessels, all of the same type—long and fast broadside wooden ships. These vessels were generally called commerce-destroyers, and it has been by many mistakenly supposed that a new type of war-ship had arisen. But in truth commerce-destroying has always formed a considerable part of maritime wars, and has been performed—or prevented—by ships of the type of the old frigates and sloops.

These fast sea-going ships culminated in the Wampanoag, of 4500 tons and 18 knots speed. She was truly a wonderful vessel, though unfit for the purpose for which she was designed; and the impulse she gave to the development of sea speed was immense and endures—perhaps to too great an extent—at the present day. The Wampanoag—even the Piscataqua and Congress—types of less radical development, have passed away. The English built the Inconstant and Raleigh; but the type of a very long and fast broadside ship, with no protection, never took root.

It soon began to be asserted—was clearly asserted by the designs of battle-ships as early as 1867—that war ships must have bow fire; and the ships of the lighter classes followed the lead immediately. There have been no ships of war, except in types designed for some special purpose, constructed since 1870 without bow fire; and few without stern fire also. It may here be mentioned that the English usually get keel fire by sponsoning out the side, and the French by recessing the side.

As regards the ratio of the total weight of bow and stern to beam fire in recent types of vessels which, in a military sense, are strictly frigates, the table will be interesting:

Class.	Displacement.	Bow.	Beam.	Stern.	Beam/Bow.	Beam/Stern.
Atlanta,	3200	350	800	350	2.3	2.3
Baltimore,	4400	700	800	700	1.1	1.1
Newark,	4100	400	600	400	1.5	1.5
Charleston,	3700	450	800	450	1.8	1.8
Chicago,	4500	650	900	650	1.4	1.4
Leander,	3700	200	500	200	2.5	2.5
Comus,	2400	100	700	100	7.0	7.0
Turquoise,	2100	100	500	100	5.0	5.0
Aréthuse,	3400	260	980	200	3.8	4.9
D'Estaing,	2400	123	493	62	4.0	8.0
Duguay-Trouin,	3200	495	514	390	1.0	1.3
Iphigenie,	3200	198	653	198	3.3	3.3
Esmeralda,	3000	400	1040	400	2.6	2.6
Sophie,	2200	186	327	186	1.8	1.8
Charlotte,	3400	224	1010	224	4.5	4.5
Fieramosca,	3700	528	1254	528	2.4	2.4
Giovanni Bausan,	3100	528	1254	528	2.4	2.4
Nani-wa,	3600	605	1585	605	2.6	2.6

This table exhibits, however, such a diversity of practice that it is doubtful if any useful rule may be drawn from it. The majority of battle-ships lately built have as heavy bow as beam fire—or nearly so—and this they reach by carrying a few very heavy guns, so mounted that they have large arcs of train. Many of the ships in the table have not really as heavy a keel fire as is claimed for them. In some cases the guns which can train in the keel-line are so near to each other that the crews of other guns will be much endangered by firing them. This is the case in a number of ships.

There is a remark of general application regarding bow and stern fire which may find a place here: this fire, to be heavy, must be concentrated in a few guns. The space available in the ends of a ship—never more than one third or one fourth of that available on the broadside—is so contracted, that it is impossible to put a given weight of guns in a number of pieces. In the list of ships given, those with heaviest bow and stern fire, in relation to their broadside fire, are the Baltimore, Newark, Charleston, Chicago, and Duguay-Trouin. These gain their keel fire in the following manner:

Baltimore, by two 8-inch guns on topgallant forecastle and poop, and two 6-inch guns on main deck; all sponsoned out to give keel fire.

Newark, by two pairs of 6-inch guns, all on main deck; all sponsoned out.

Charleston, by one 8-inch gun amidships, and a pair of 6-inch sponsoned out; all on main deck.

Chicago, by a pair of 8-inch guns on upper deck, and a pair of 5-inch on lower deck; all sponsoned out.

Duguay-Trouin, by three guns of 19 cm. mounted on the forecastle; a pair in sponsons, and one in the eyes of the ship.

None of these ships, it may be observed, mount guns in turrets or barbettes in pairs, a method much used in battle-ships. The advantages and disadvantages of mounting a given weight in one or two guns in a turret may be shortly stated as follows: the two lighter guns will require rather less weight of armor to protect them by the same amount as the large gun; while, the total weight in guns being supposed fixed, the caliber of the smaller guns will be eight tenths of the large one. Thus we shall gain some weight in armor, lose one fifth in penetration, and gain in rapidity of fire—or number of hits—by substituting a pair of guns for one gun; the weight being the same.

It is not quite in the line of the argument now in hand, but our attention may be drawn for a moment to a peculiarity of the class of cruisers lately laid down in this country. We have followed our historical policy of building ships larger than the corresponding types in other countries, in all of these. The Baltimore, Newark, Chicago, Cruisers No. 4 and 5, are all of more than 4000 tons; the Chicago and Baltimore being of about 4500 tons, while the Charleston is of 3700 tons. Vessels, then, of about 4000 tons, or a little above, form our unarmored (so-called) cruiser class; while the corresponding vessels in England are of about 3500 tons displacement and less. We have but to increase the Chicago's tonnage to 5000—one ninth of itself—to reach the displacement of the Aurora class in England; ships carrying 10 inches of compound armor on a waterline belt extending two fifths of their length. The English Mersey of 3500 tons, and the Chicago or the Baltimore, are classed as protected cruisers; their protection consisting of a complete underwater protective deck; and though we may conclude that the American ship, in a fight between these ships of nominally the same rate, might win, as did our ships in 1812, yet we must not forget that as between the Mersey and Baltimore—and Baltimore and Aurora, there is not much difference in tonnage, the true measure of fighting power.

The way of measuring the weight of battery that has been adopted—adding up the weights of all the projectiles thrown—is the one generally used; but it is not entirely satisfactory, because it does not tell us whether the weight is in few or many projectiles. It appears to be, however, the only way short of a complete description of each battery, and as such has been used. There can be little doubt that if ships are to carry one or two guns of heavier caliber than the others on board, these guns ought to be mounted in the bow and stern and on elevated decks, because then they get the largest arcs of train. It is by no means uncommon now to find the heavier guns mounted higher from the water than the lighter ones—just the contrary of the practice which formerly prevailed. This feature will be found, for example, in the U. S. armored battle-ship, the Chicago, and the Baltimore. It appears to me, also, that the place for an armor-piercing gun in an unarmored ship is the stern, because, if she is engaged with an armored vessel, it will generally be in chase.

Our gunboats Nos. 1, 3, and 4, of 1700 tons, and even gunboat No. 2 of 900 tons, are protected cruisers, and would be classed as such in England or France. The larger class, it appears to me, would be most useful vessels in war time—being able, as they are, to perform all the functions of war except fighting in the line. The contract cost of gunboat No. 1 is $455,000, while that of the Newark is $1,248,000—nearly three times as much. While of course the Newark is much the more powerful vessel, yet there are a great many duties in war which were formerly performed by frigates that can be as well done by the smaller vessel as by the Newark. The Newark carries twelve 6-inch guns, and three gunboats like No. 1 would carry eighteen of the same caliber; the protective deck of the gunboats being complete and three-eighths inch thick, their defense is of only one eighth the power of the Newark's.

The table below will give a comparison of the powers of the Newark against three of Gunboat No. 1.

	Displacement.	Cost.	Speed.	Battery.	Protection.
Newark, ...	4083	$1,248,000	18	12 6″	2″ to 3″
Three gunboats, .	5100	$1,365,000	16	18 6″	$\frac{3}{8}$″

Our gunboats, it may be observed finally, approach very closely in tactical features the Scout, Archer, and Condor types of England and France. They will have eight torpedo-ejectors.

Besides the vessels which may be said to have taken the place

of the frigates and sloops of old, there are the smaller and more irregular classes of vessels; including, at the present time, torpedo, gun, and dispatch vessels and boats. Among these are the Alacrity and Surprise, in England, and the Archer, Scout, and Grasshopper classes; in France, the Condor and Bombe classes; in our own country, the dynamite vessel; and in France and England a large number of small gunboats of various types, such as the English Staunch.

The Alacrity and Surprise are usually classed as dispatch vessels. They are of 1400 tons displacement, have a speed of 17 knots, coal endurance of 6500 knots, and carry four 5-inch rifles and a secondary battery. They have complete protective decks three-eighths inch thick. These vessels are about the tonnage of our gunboats Nos. 1, 3, and 4, and of the Dolphin; but are superior to the Dolphin in all military qualities.

The Scout and Fearless are torpedo cruisers, a class of vessels which are intended to accompany the battle-ships anywhere, and to aid them in engagements when possible. They are of 1430 tons, have a partial protective deck three-eighths inch thick, carry four 5-inch rifles, and are supplied with eleven torpedo-tubes which are worked behind light protection.

There can be no doubt that this class of "enlarged torpedo boats," as these vessels have been called, has obtained a considerable measure of approval; for the English, a year after laying down the Scout, laid down the six ships of the Archer class—vessels of 1600 tons, of very similar tactical features. But here, as so often in our study of the development of types, we find a slight recoil from a position lately maintained—the evidence of the continual motion to and fro of opinion regarding the features of naval war. The Scout puts her trust in eleven torpedo-ejectors, a partial three-eighths inch deck, and four 5-inch guns; the Archer, on a slightly greater displacement, has only eight ejectors, a complete three-eighths inch deck, and six 6-inch guns. In 1885 the French laid down the four torpedo cruisers of the Condor class. These are of 1300 tons, and carry five torpedo-ejectors and five 10-centimeter guns. They are protected throughout their length by an underwater deck which varies from 1.5 inch to 2 inches in thickness.

The English Grasshopper class and the French Bombe are classed as torpedo hunters. They are small vessels, of high speed and light draft, so that torpedoes may pass under them; and are usually

armed with a gun of 4-inch or 5-inch caliber, and several R. F. guns. These vessels are intended to accompany the fleet, but perhaps not to great distances. Our dynamite vessel, now constructing, has attracted a great deal of attention, and doubtless will fill an important special place in war. She will not, however, contend with other vessels of similar type on the ocean, and is not, therefore, destined to become a type of cruiser.

The French and English have large numbers of gunboats carrying one or two guns of calibers from five inches to ten inches. The English gunboats of the Staunch type, for example, are of from 180 to 250 tons displacement, and carry one heavy gun so mounted that it can be lowered below the deck when at sea. The impossibility of giving such small vessels effective protection is probably the reason why they are not favorably regarded; and the attempt to build them in place of large ironclads, which has sometimes been advocated, seems now to be finally abandoned.

We have finally to sum up our review of the history of the types of war-ships, and to endeavor to draw conclusions as to naval tactics from it. Nothing has so much struck me, in my reading and study of this subject, as the similarity of the broader features of naval warfare in all time. The sea-captains of the period of sails had but one principal weapon to use—the gun. We now have three, and naval tactics have been greatly altered by the change; but, at the same time, the purposes, aims and objects of naval warfare have changed so little that many of the broader tactical features which are now required in classes of ships were required formerly also.

We recognize all through the seventeenth, eighteenth, and first part of the nineteenth century three main classes of war-ships: ships of the line, frigates, and sloops and brigs. The office of the first class was to contend with similar ships of other navies. It appears that we are warranted in concluding that their size was determined by this test—that they were as large as the actual state of the shipbuilding art would permit; and, though their power of offense was considerably in excess of that of frigates, yet the ratio of their offense to defense did not differ very widely from that existing in frigates. Finally, as an off-set to their great fighting power, they lost in mobility; they were less weatherly than frigates, and consequently could not gain or maintain a position as well; and also, from their greater draft, were unable, in some cases, to go where lighter vessels went safely.

The sailing ship-of-the-line was then made as large as possible, and possessed many military qualities in a lower degree than frigates, or even sloops and brigs. The only reason they were built was that they were the most powerful fighting ships which could be made, and because other nations possessed them. They were, however, fit for nothing but to contend with each other, and occasionally with forts on shore.

The frigates were swifter and more truly sea-going than the ships of the line. In a pecuniary sense they were a better investment of a nation's money than the liners; but, for all that, they were not able to displace these latter. Their office was, in fleet operations, to see and feel for the heavy liners, and, in some cases, to provision and water them. They also performed important work in the way of patrolling trade routes, convoying, and destroying the enemy's commerce. Frigates were everywhere useful, and service in them was always popular, so that a large part of the money expended on navies was put in them.

The sloops and brigs as a rule performed little work in connection with fleets. Many of them were too small to accompany the heavy ships in all weathers; and they were never as well able to tow a disabled liner, or take possession of a subdued enemy's vessel, as were the frigates. In destroying enemy's commerce, these small vessels were as useful as frigates, however; except of course that they were in great danger of capture if they fell in with a heavy ship of the enemy. The brigs and sloops were the corsairs, the guerillas, of naval warfare.

It might have at first appeared to the preparers of naval estimates and to the designers of war-ships, that naval warfare might with advantage be made a war upon commerce alone—a war carried on by numerous Alabamas—and that, therefore, there was no use in building ships of the line. This view, it would appear, might very reasonably have been taken by the enemies of countries strategically situated as Spain, Holland, and England successively have been—the mother country, united by long and rich arteries of commerce with her distant colonies.

But history positively stamps this policy as false. Never has a powerful impression been created in war by mere commerce-destroying—by the capture and destruction of ships. The effect upon the enemy of destroying his merchant ships has always been to cause him to put forth greater effort; to build fleets of powerful

war-ships that, he hopes, may destroy the thing which is annoying him. The control of the sea has, again and again, powerfully contributed in deciding great wars and the fate of nations: as in our Revolutionary and Civil Wars, not to go outside our own history. But this control has been, and must always be, decided by battle-ships, by war-ships which, when united in fleets, can overcome the enemy's fleets. The maritime power of Spain was thrown down by the destruction of the Armada, and not by the previous exploits—brilliant and stirring as they were—of Drake, Richard Grenville, Hawkins, and others of the splendid galaxy of seamen of the Elizabethan era. Blake's fleet victories over the Dutch,and not the capture of single Dutch ships, gave England the carrying trade of the world. Hawke, when he destroyed the French fleet in Quiberon Bay, saved England from an invasion; Nelson again, by his sleepless watch of the French fleet, and by his brilliant victories at the Nile and Trafalgar, twice overthrew the strategic combinations of far-reaching importance of Buonaparte. In our own country, the command of the sea about our coast, held towards the close of the Revolution by the French fleet, contributed most materially to the happy issue of the war; the victories of M'Donough's and Perry's fleets on the lakes greatly influenced the conduct and consequences of the War of 1812; and Farragut, when he passed up the Mississippi, struck a heavy blow at the power of the Confederacy.

And yet, in this country, we talk of not building battle-ships. As well provide an army to consist of isolated companies, whose organization and drill contemplate no union of more than two or three companies, upon extraordinary occasions. Our frigate and sloop victories in 1812, the victory of the Kearsarge over the Alabama, were soothing to the national pride and beneficial to the cause of the navy; but they contributed in no material degree to the result of the wars in progress. It may be that the battle-ship now adopted in Europe and elsewhere is tactically unsound; but, if this is so, let us find the true type, and not put our faith in frigates. It is unworthy of a great nation like ours to contemplate privateering warfare alone—a war of guerillas.

Yet this is certainly what some of us do contemplate; at least as far as offensive naval operations go. It may be that the Government will be strong enough to induce the nation to accept a war policy to consist in shutting ourselves up within our shores, submitting to the insult of our ports in some cases, and repelling these with torpedoes

and guns mounted in tugs and other river craft in others. But this I doubt. And what can we do in the way of maritime operations, against even nations whose wealth and power are insignificant as compared with our own? You cannot send a regiment of men to march through a country held by armies. A naval policy which builds no battle-ships does not contemplate war, but privateerism.

Our geographical position, as regards any war whatever, except one with Canada or Mexico, resembles exactly that of England. Whether it were a war for national existence, waged against a combination of powerful European nations, such as might have occurred in the Civil War; or a petty war, arising from some trifling dispute, fanned into war by injudicious diplomacy, it must be maritime. The control of the sea will be the supreme question. We have one advantage over England, it is true, but even this ceases to have effect if it be true, as I have said, that the control of the sea is the question of most moment: I refer, of course, to the question of the food supply of England, and to our own independence in this respect. The United States, however, will never consent to be shut up within its borders in case of war; and bitterly we shall repent our short-sightedness, and loud will be the abuse of the Navy, when it is found that our large steel cruisers, upon which so much national interest has been centered, are powerless to drive the enemy from our doors.

A battle-ship, then, is as large a ship as can be built, and conveniently and safely be navigated and fought. A frigate—to generalize this term—is a smaller vessel, which, in fleet operations, accompanies the liners, and sees and feels for them. Frigates also perform many minor and very necessary duties. The sloops—to generalize this term also—are sea-going craft smaller than frigates, whose functions are more purely commerce-destroying and protecting than frigates. We operate, in naval warfare, for the control of the sea, which the enemy tries to hold by his battle-ships, while his own and foreign merchant ships supply him with every necessity. We strive, by bringing his fleets of battle-ships into pitched battles with our own, to destroy the true guardian of his sea power. Our sloops, meanwhile, operate on the merchant ships going to his ports, and evade the battle-ships, whose attention is necessarily engaged by our fleet. Our frigates stand between these two classes, and help each as they can.

Such a view of naval warfare may perhaps be accepted as a general one, applicable to any age or combination of weapons. Or, if the

precise scheme here drawn up is erroneous, there yet is a general view, of the nature here sketched out.

Such a view will, by discovering from the history of wars the objects of navies, in some measure help us to decide on the principal characteristics of the various classes, as preliminary to fixing upon the installation of weapons. The type battle-ship already mentioned, of about 6500 tons displacement, comes within the definition of what a battle-ship should be—as large as convenient. We have, in our country, special reasons for limiting the draft of ships to not more than twenty-two feet at the outside; and it will be hard to build a ship of 6500 tons or more with less draft. This ship should carry probably guns of about 12-inch caliber, and, to narrow the matter down still more, two such guns might be mounted in a turret armored with ten inches or twelve inches of steel; and the ship might carry in addition a battery of numerous 6-inch or 5-inch guns. These should be protected by stout steel shields, of such form as to give efficient protection.

The frigate should be of about 3500 tons displacement. The ratio between the offense and defense in these ships should approach that existing in battle-ships. This, it may be observed, is the direct contrary of the rule of practice now adopted; for no vessels of 3500 tons are *armored*, but are *protected*—to use the phraseology now current; and in all protected ships the offense exceeds the defense far more than in armored ships. This will require frigates—or "second or third class protected cruisers," as they are frequently called—to be better protected, and their guns to be lighter than now. The protection to the ship herself may be in the way either of a vertical armor belt at the water-line, or by a protective deck. The guns and guns'-crews must also be protected better than they are now, as a rule. Armor three inches or four inches thick, and so disposed as to receive blows in a glancing direction, will give protection in many cases, and should be applied athwartships and wherever necessary on the beam.

To decide upon the offensive and defensive arrangements of a frigate, if we admit a certain ratio of power between these, it is sufficient to decide upon their guns. These probably should be of about 5-inch caliber. Guns of 5-inch caliber, though usually not dangerous to the supposed battle-ship, would yet be so if she were disabled, and if the range were very short. If one or two heavy guns in addition to the battery of 5-inch guns were desired, they should be of full

9-inch bore. My view of large guns in small ships is, however, that they will be useful only in the irregular operations of war—bombardments, the capture of disabled ships of higher rates, etc. The rule will be in the future, as in the past, that vessels will contend with their likes; and of two frigates of 3500 tons, one carrying two 9-inch guns, and the other an equal weight in twelve 5-inch guns, the latter has certainly the best chance of winning.

The sloop type-ship should be of about 1500 tons displacement, and their batteries would be mostly of guns of about 4-inch caliber. Here, too, my view is that present types lack in defensive arrangements. The ⅜-inch protective deck of our gunboats and of the class of the English Archer will hardly throw off a 3-pounder R. F. gun when the range is short; and yet the two classes named are the best protected in the world for their tonnage.

The scheme presented of a convenient classification of war-ships is, of course, open to criticism in all respects; and perhaps the best result which can flow from its presentation is the realization of the necessity for a comprehensive plan. The growth of a type of war-ship is an extraordinary and most complex study, and all that any individual can do to fix or control it is infinitesimal in amount.

The scheme presented lays down, from a study of naval wars and of present needs, the three classes of battle-ships, frigates, and sloops. The first we make as big as is safe and convenient; their office is to fight similar ships. The third must be fast sea-going vessels of high coal endurance; their office is to stop the enemy's commerce and protect our own; incidentally they fight vessels of their own class and run away from larger ones. The second—the frigates—are intermediate in every respect; their first duty is to accompany and help the fleet of battle-ships; incidentally they perform all the duties laid down for sloops. We may arrange the three classes in a table as follows:

	Displacement.	Heaviest Gun.	Heaviest Armor.
Battle-ships, ...	6500	12 inches.	12 inches.
Frigates, ...	3500	9 "	6 "
Sloops, ...	1500	6 "	4 "

Now, what does our examination of the types of ships teach us of naval tactics—the tactics of sea-battles? In the first place, will the tactics of battle-ships, frigates, and sloops, whether in single combat or fleet actions, differ? If the tactical features of these classes differ as much as they now do, their tactics must differ; but if their tactical

features will be the same, their tactics will be the same, as in former times they were the same. That the frigates and sloops shall approach the battle-ships in tactical features, it is necessary that their armor shall increase, and that they shall carry a heavy gun with a large arc of train; a feature now found in many frigates, as the Charleston, Baltimore, Atlanta, Chicago, Mersey class, and nearly all French cruisers.

If, then, the tactical features of war-ships of all classes are approaching similarity—the differences being even now more apparent than real—the fighting tactics of all, whether engaged singly or in fleets, will be the same. If the guns of ships are so installed that they have equal all-round fire, they have no preference for one angle of presentment more than another. The line of bearing in fleet formations may then, so far as the question of bringing the guns to bear is concerned, have any direction whatever with respect to the direction in which the enemy is seen. The defensive arrangements of ships—the ratio of their offense to defense on various presentments—will control the range. If these defensive powers approach equality in all directions, as it appears to me logical that they must, if the powers of offense are equal all round, then the gun lays down no tactical rule whatever, except that it prefers that the range should have a certain value. The Monitors—to which type the battle-ships of all nations now approach in tactical features—laid down nothing as to the angle of presentment. In a purely gunnery duel between two of them, the only datum we need know, for a complete understanding of the contest, is the range.

A word may be said finally in defense of the use of the old words frigate and sloop, instead of some of the infinity of new names which have been invented to designate vessels whose functions would be the same as those classes. These new names are intended usually to convey something as to the tactical features of a ship—to indicate in some degree how thick her armor is, and how it is disposed; and to show whether her powers of offense are lodged principally in gun, ram, or torpedo. But, as already stated, the existing differences in these respects, except in the matter of armor, are small, and they are growing still smaller; in other words, the sloop of the future may be very nearly produced by a parallel contraction in all respects of the battle-ship.

As to the strain put upon the old meaning of the words sloop and frigate—the meaning with which we are familiar—it is not very great;

not greater than the changes of meaning they underwent before reaching the one we know. It does not seem possible to discover how the term sloop came to be applied to a ship-rigged war-vessel carrying guns on one uncovered deck, though James has something to say regarding the origin of the term. The word frigate passed through a variety of very different meanings, to be applied finally to a ship-rigged war-vessel carrying her guns on one covered deck. The old word ship-of-the-line we have changed to battle-ship; a good term, and one firmly lodged in naval terminology. This word alone, among those formerly used to designate different classes of war-ships, has a distinctly military origin. This is probably due to the fact that, of these classes, the ship of the line alone had a distinctly military origin and purpose.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

A STUDY ON FIGHTING SHIPS, BY K . . .

Translated from the French (" Le Yacht ") by Professor JULES LEROUX, U. S. Naval Academy.

The late controversy between distinguished officers of the service has given the naval question great prominence in France. This interest is, besides, increased by the disquieting rumors incessantly arising in Europe. Should war be declared to-morrow, our fleet, say many officers, would be ready to cope with that of any nation; while others, less sanguine, pretend that our *matériel* is not in keeping with the kind of naval warfare likely to be waged now-a-days, and even say that many ships in our ports could only be gotten ready after long delays. We have here to deal with such a complicated subject that we can easily conceive of a diversity of opinion among the officers, and even in the mind of the Board of Admiralty. The problem, we say, is complex. Naval operations differ entirely from army operations. We are reduced to conjectures in regard to future events, for no fixed theory has so far been established by experience. There is no naval war that could enlighten us by its examples. The battle of Lissa is far too obsolete. China, whom we had to chastise lately, can in no manner be compared either to England, Germany, or Italy; nor does the Turco-Russian conflict disclose any instructive past in sea matters; and to seek in the struggle between Chili and Peru for any useful hints, in view of a European war, is out of the question.

What is then more natural than to find adherents to several adverse theories, and all equally convinced?

We regret to state that we do not think our *matériel* is up to the requirements of the wars of the future. Besides, the number of powerful ships ready, in a single day, to fall into line is too small, and, owing to the complicated nature of our armored vessels, at the

moment of putting out to sea some sudden hitch is bound to occur to cause delay. It is not making too bold an assertion to say that no vessel is ready that has not been in commission for some time. The most regrettable part of it is that no effort is made to find a remedy and enter upon a new course. For the very reason that doubt assails the minds of many concerning the type of ship to be adopted, experiments should be multiplied in seeking a solution of the problem.

What do we possess to-day in the shape of fighting elements? Armored battle-ships? Italy has built colossal ones, and so has England for that matter. Guided by better counsel, we refrained from following the latter nations in their progressive tendencies; nevertheless, we have enormous masses, weighted down with all the modern machinery, all the modern improvements. Do these excessively large and costly vessels really possess advantages so very numerous as to justify their existence?

More or less invulnerable at their water-lines, are they not liable to be hit below by a ram or torpedo, the same as any ordinary cruiser? And will not the same agent equally send to the bottom two vessels, of which one may be ten times more important and expensive than the other? These ponderous ships, intended to crush the enemy's fleet, will find themselves confronted with terrible foes. Since a single blow from ram or torpedo will suffice to cause their total destruction, may not that blow be struck in battle without any possibility of averting it? I will venture further and ask, Will it not be a mere stroke of luck, good or bad, according to circumstances, that will permit the adversary to strike a mortal blow? Will not the unexpected have a large share in the struggle between two otherwise equal naval forces, and will not that terrible hazard, acting as an ominous menace to the destruction of these powerful units we rely upon now-a-days, be the cause of an irremediable disaster?

What, then, will be the nature of the struggle between two opposing squadrons? When two hostile fleets bent on fighting confront each other, in most cases the engagement will be a hand-to-hand combat. Ships of the latest designs are generally armed with powerful bow-chasers; all will find an advantage in bearing down upon the enemy end-on, in order not only to present the least surface target to his fire, but also to protect their water-lines against the dangerous effects of his projectiles.

In fact, a shot directed against the bow can only hit the armor in a point of the receding line of the ram at an angle such that very

often it will glance off, or at any rate its penetration will be greatly lessened. Hence two squadrons standing within firing distance will rush upon one another with a speed that, as is now generally admitted, would be equal to twelve miles an hour, or twelve meters per second. This will be indeed a momentous hour when two powerful hosts, within a mile apart, are about to close in a death struggle.

Suppose one vessel wishes to elude another's attack, what will her captain do? Will he put about while he has just yet time to perform his turning manœuvre? Certainly not; for he would thus expose his broadside, at a fair firing distance, to the enemy, and by running away, uncover his rudder and screw, for a more or less brief space, to be finally forced once more to present his broadside in order to escape from this the worst of all situations. On the other hand, he will not steer a course perpendicular to the first; his enemy would equally possess the best advantage in bearing down upon him. He will then simply sheer off to elude the enemy, and will, for instance, alter his course 20° to the right. But by this manœuvre he will still place himself at a great disadvantage, the enemy always presenting his bow and having a larger target for his fire. Besides, he would be exposing himself to a ramming attack. Neither commander will, therefore, deviate much from his course; and at the moment of the shock, each watching keenly the vessel before him, will aim principally at ramming, sheering neither to port nor starboard for fear of placing himself at a disadvantage, and will rush upon one another like two mad bulls. In most cases the ram will not be able to cut into the receding forms of the bow; there will be only a dislocation, causing a more or less serious leak, and the two masses will rush past each other in opposite directions with a grating, crashing noise, levelling everything outstanding in their mad progress. Guns run out, projecting sponsons, everything may be torn away, stove in, smashed. I do not mention the Bullivant nettings; the ship that should happen to have them set would have her screw fouled or bent, with, however, an equal chance of disabling the enemy in the same way; but it is not a safe game to indulge in. After steaming along and past each other in a few short but awful minutes, the adversaries will endeavor to turn rapidly and attempt to strike the foe before the latter has had time to complete his evolution, and the combat will present a series of passes in which the ram, the artillery, the torpedo, and the torpedo-boat will play combined parts. After a few moments the battle will become a general mêlée; several

vessels will meet with mishaps, they will lose their speed, and combined action will be out of question. Vessels still uninjured will keep their speed, and will meet here a friend, there a foe, perhaps in less than a minute's interval. The greatest coolness and determination and a quick eye will be necessary on the part of commanders; the least hesitation would prove fatal in the midst of the menacing rams. Many a cannon shot, many a launched torpedo will miss its mark and strike a friend.

The struggle will be indeed terrible, but it will be short. The ram alone, if brought into play, would make quick work of the whole affair. At the end of an hour, in less time perhaps, how many wrecks, what an immense havoc! What will there be left of so many millions of accumulated treasure, of hundreds of brave men?

Which of the two squadrons will come out victorious in the contest? Will it be the one that possesses the better commanders, the better gunners, the better ships? Its chances would be great indeed, but, on the other hand, what a vast field is left to hazard! Here we see an armored battle-ship, with her machinery disabled from the effects of a torpedo fired by her consort; there, on the contrary, a luckier one, in the thickness of the blinding smoke, finds herself unexpectedly in the most favorable position for ramming a foe, manœuvring with perfect ease, yet obliged to sheer off to elude the attack of a first adversary; another has her steam gear disabled at the moment when her helm is hard down, and before her commander, irresolute in the conning tower, has time to realize the extent of the mischief, before the order to rig another tiller-rope is given and executed, two minutes elapse, and he is about to collide with a friend, or is in a critical situation before an enemy's ram. On board another vessel, the captain and executive officer have both been killed by the same shot, how many irreparable incidents may take place before the third officer or else the nearest one at hand has had time to assume command. Woe to the ship that remains for a moment without answering her helm!

Would it not be advisable to leave less to hazard and adopt smaller tactical units, which, being of course exposed to the same dangers would be equally fated to perish, but would in their destruction involve only the loss of a few men and a little treasure, instead of carrying down to the bottom five millions of dollars, a crew of eight hundred men, and a staff of twenty officers? Is it not an undeniable fact that, if it is necessary to leave a share to chance, that

share should be made as small as possible? Since we cannot ward off entirely these disastrous blows of fate, is it not natural that we should try our best to lessen their consequences, and how can this be better done than by that division into small fighting units that we advocate? When we reflect that the finest ships in our fleet might be lost on the single throw of the dice, so to speak, it may be pertinent to inquire if it would not be wise to adopt some other means of action, as part compensation, at least, for such an immense loss. And all this is no idle supposition; whoever has witnessed a squadron manœuvring knows what constant vigilance is necessary. An accident to the engine or to the helm, the misunderstanding of a signal, may occasion the loss of two vessels, even in a smooth sea and whilst going under easy steam; think, then, of the enormous increase of the difficulties on that momentous day that is to decide the supremacy of the sea, when the thick smoke arising at each discharge of a heavy gun, the deafening din of the artillery, will be a constant obstacle to seeing and hearing. How many signal-quartermasters will be disabled? How many others, in the midst of the fusillade, and the bursting of shells from revolver-guns over deck and bridge, will lose their usual coolness and commit blunders which the officer intrusted with that special duty will not be always able to remedy. And to show what a delicate and dangerous manœuvre, crossing the lines while advancing to an end-on attack is, even with friendly squadrons, in the finest weather, and with increased intervals, this evolution, one of the best as affording commanders practice of the eye (*coup d'œil*), is rarely attempted in our Navy.

What will then happen on the day when not six, but twenty-five and even thirty armored battle-ships confront each other in deadly strife? What a contrast between the timid evolutions in time of peace, and the bold, decisive movements executed in action! I do not mention night attacks; for hazard then would not only be an important agent, but a preponderant factor, and an action at close quarters is not to be thought of under such conditions.

It must be confessed that what I have just described refers more particularly to a hand-to-hand combat, a mêlée between two squadrons. If the latter fought at a distance, with artillery alone, the share of the unexpected would be greatly diminished. But once more, will the battles of the future begin by the combatants presenting their broadsides to each other, when those sides are the most vulnerable points, when a lucky shot may wreck the engine, and a

target four times as large is offered? I do not think so, and I am not the only one, else armored ships would not have been provided with rams, neither would such ingenious precautions have been taken in arming them so formidably with bow-chasers, or supplying them with torpedo-tubes, it being admitted that the Whitehead should be fired off only within a distance of four hundred meters. Besides, in order to join battle in the above fashion, customary in former times with sailing vessels, but contrary to the tactics of the present time, it would be necessary for the combatants to be of the same opinion. If one squadron bears down upon another, the latter will unhesitatingly do the same, unless he be sure of possessing superior speed; and particular considerations, such, for instance, as unquestionable weight of metal, deter him from engaging at close quarters. But we must reckon upon a hand-to-hand fight as being probable. One is never certain of commanding a squadron possessing greater speed than the enemy, especially when it is borne in mind that a mishap to a single vessel is of frequent occurrence in an engagement, and will delay the progress of the whole fleet. We are therefore of the opinion that engagements at close quarters will be the rule, and hence hazard must be considered a far more important factor than it used to be during the continental wars. Now, according to our idea, small tactical units would be an excellent means of diminishing the disastrous effects resulting from the intervention of hazard alone.

All have still fresh in mind the experiments of Admiral Aube during his short presence in office as Minister of Marine. Torpedo-boats and the *bateau-canon* became famous under his administration. It cannot be denied that these experiments were a failure: but his adversaries took an unfair advantage of this fact in opposing his ideas to the extreme. Because the torpedo-boat of 35 meters was unable to keep at sea in all sorts of weather, is no reason why deep sea torpedo-boats should be useless, for, just in the same way, there is a wide difference between a *bateau-canon* and a 10,000 tons battleship like the Courbet, and without making the former so small, they might have built the latter smaller. Those experiments have besides proved nothing in favor of the armor, and we frankly confess that since making these naval questions a study, we have become the adversary of the water-line belt. There are three kinds of naval weapons: the gun, the torpedo, and the ram. The last two *always* strike below the water-line, the first *sometimes* only. What would

be thought of a wall exposed to divers attacks whose summit alone would be protected? Of course a comparison is hardly ever exact, but it helps to get at the truth. Let the guns and the redoubts be protected by armor plates, let even the guns be placed in turrets for still better protection ; in fact, protect from shot and shell everything that is liable to be injured by those missiles alone, and we will say nothing better ; indeed, we are of opinion that the heavy guns are not sufficiently protected, and that the system which consists in sheltering the carriage and covering the piece with a mere mask may prove disappointing when the enemy's rapid-firing guns of small and medium caliber come into play. But to protect the water-line alone when, one meter below the reach of the gun, the torpedo may open a gap four or five times as large, and with this object, to burden the ship with an enormous weight, is an insufficient palliative, and besides a costly one.

But Admiral Aube laid himself open to a too easy attack ; he felt too sanguine of success, and put too many trump-cards in the hands of his adversaries. The two forces opposing each other during the great manœuvres of 1887 were out of proportion. Admiral Peyron's squadron, estimated in men and money, was worth ten times that of Admiral Brown. Yet, when it is sought to find the advantage of one system over another by actual experiment, it would be only fair to grant both sides equal facilities. Besides, the cruisers attached to the torpedo-boats were too slow; finally, the torpedo-boats of 35 meters were too lightly built, and equally slow. Now it was admitted in the new theories that the strength of the torpedo-boats lay in their superiority of speed. The contest was too unequal, and sufficient account was not taken of the conditions of the problem. The experiment was bound to fail. Much talk was created on account of the minister's discomfiture, and justice was not done him. In spite of this first check of the small vessels, however, the primary idea exists in its entirety, *i. e.*, the idea of creating small fighting units. To plan a vessel of just the dimensions that would allow of her keeping at sea in all sorts of weather, and of her launching her torpedoes in spite of a heavy sea, remains still the problem to be solved.

By unanimous consent, the present torpedo-boat of 35 meters is too lightly timbered. But why stand still after a first failure? Let the same experiments be made on a series of superior types, and, according to the law of progression, success is certain before attaining a displace-

ment of 1500 tons. The Ouragan, whose construction has been given out by contract to private industry, is a step in this direction; but, in our opinion, this type is yet too light. Now, what have we in the service superior to the Ouragan? In the first place, the torpedo-chasers (*contre-torpilleurs*) type, Couleuvrine, Bombe, Lance, etc., whose displacement is about 350 tons. So far, these vessels have been provided only with torpedo-tubes placed forward in a position unfavorable for launching in all directions. On the other hand, they have proved, if not remarkably, at least sufficiently, seaworthy. The Couleuvrine, long attached to the training squadron, has followed the latter constantly, and if she put into port, it was only in order to give the overworked crew a needed rest, and not from stress of weather, for her safety was never in doubt. This class of vessels is still subject to constant rolling, which would be a sure inconvenience in launching torpedoes off the sides; nevertheless, good results may be expected from them. Finally, in the way of fast ships provided with torpedo and having a displacement superior to that of the Couleuvrine, we have the torpedo-cruisers Condor, Faucon, etc. The first of these vessels was attached for a year to the training squadron, and gave proofs of her great stability under all circumstances. In regard to this class, doubt is no longer admissible. With tubes sufficiently raised above water, which can be easily done, they can launch their torpedoes under the most favorable conditions. But we have already reached a displacement of 1300 tons, and a sum of more than two millions of francs, the cost of the Couleuvrine being about 1,200,000 francs. But the distance is great from the 350 tons of the Bombe to these 1300 tons, and we are of opinion that between these two extremes will be found the tonnage of the vessel sought, a vessel capable of keeping at sea and launching her torpedoes in spite of wind and wave, and at the same time sufficiently comfortable for the crew. Again, what is there to prevent forming, in time of war, two sets of commanders, officers, and crews, relieving each other at short intervals, one set resting on shore and recuperating strength for the next turn, while the other set is at sea? A serious effort should be made to realize this mean type of vessel, and three or four fast ships built displacing from 600 to 1100 tons. For, once more, where the torpedo-boat of 35 and even 45 meters will fail, that of 55, 60, or 65 is bound to succeed. The cost is not so great that it cannot be risked. The experiment would be decisive, and the millions wasted in building worthless vessels would be saved

ten times over. Four ships at 1,500,000 francs each, a very ample sum, would make 6,000,000, which is an insignificant amount of money compared with that voted every day by the Houses. The adoption of the new class of torpedo-boats would, besides, have another and indisputable advantage. Everybody knows that the weapon intended to destroy what has been designated as "the microbes of the sea," is the Hotchkiss gun, firing very rapidly, certainly twenty shots a minute. The little room taken by these guns, and their comparative lightness, have permitted their being multiplied on board and mounted everywhere. In each top of a large armored ship there are two, and even four, of these weapons. But their power is limited; the force of penetration of their shells is relatively small, and a comparatively light armor is proof against them. To be sure, Hotchkiss guns of a heavier caliber have been built lately, and their power is sensibly greater; but with these rapid-firing guns the limit of power is soon reached. The revolver-cannon, with multiple barrels, has been superseded by the single barrel rapid-firing gun. Special arrangements allow of its sufficiently rapid loading and firing, though in this particular it is inferior to the Hotchkiss. But let the size be increased ever so little and we reach a caliber that cannot be exceeded whilst maintaining the suppression of the recoil, that is one of the essential conditions of rapid firing. For this reason repeaters, or at least rapid-firing guns, will always be of small caliber. We are quite aware that England is experimenting with Armstrong guns of 12 cm. and 134 mm. firing from 10 to 12 shots a minute. With these new pieces, the placing in position after each recoil is automatic. But it is evident that the recoil, exclusive of the unavoidable loss of time, increases considerably the space taken by the guns, thereby limiting their number. Besides, the placing of relatively heavy caliber guns in the tops is a very difficult operation, not to say an impossible one. The exclusive protection of a large armored ship, consisting, therefore, of rapid-firing guns of small caliber, if we should build torpedo-boats of a heavier type than those now in the service, the Hotchkiss shells and the shots from rapid-firing guns would no longer be able to destroy them as they would our present ones, and the principal bulwark of armored ships would be rendered useless. This fact is worthy of consideration.

A torpedo-boat of the type we advocate above would certainly be capable of carrying light armor sufficient to resist the shells of rapid-firing guns. A protective deck placed somewhat below the water-

line, and, above the latter, a coffer-dam belt along with coal bunkers, etc.—the cellular system, in short—would insure complete protection to the vessel. As a matter of fact, the Faucon and Condor are provided with a protective steel deck running the whole length of the ship, of four centimeters thickness, quite sufficient to resist projectiles of 14 cm. striking at a necessarily sharp angle. Below this deck is, moreover, placed a jacket of light sheet-iron as a further protection against splinters and pieces of shell which otherwise might find their way into the engine-room. It is not necessary at present to go to that extremity, a lesser thickness being, we believe, sufficient for our lighter type of vessels. Finally, the torpedo-launching tubes, four in number, of which two at least should be fired broadside, ought to be also protected with carapaces of sufficient thickness.

We may perhaps incur the reproach of running down our heavy armored battle-ships in order to make room for small ironclad ones. "How! you condemn armored ships and protect your torpedo-boats with plates; but we, the champions of the big fighting units, will oppose to your plates heavier rapid-firing guns, and thus by degrees bring you back to those very armored ships whose necessity and even usefulness you now deny." You are mistaken! Against torpedo-boats you do not require heavy guns, whose fire is too slow, and the smoke blinding, when there is no fresh breeze; but, on the contrary, light, handy, quick-firing guns, so as to fire almost without aiming, correcting only the fire by the continuous fall of a shower of projectiles. To pierce a chrome-steel plate of only four centimeters, forming a protective deck, it will be found necessary to increase the weight of the present light artillery. You may apply to these guns all the improvements of modern invention, work them by steam by means of a lever requiring only the strength of a child to move, there will still be lacking the most indispensable thing for placing these necessarily numerous guns, and that is room. Where you might have set fifteen Hotchkiss guns in the tops and on the taffrails, in order to protect a momentary retreat, you will have only three or four of these pieces, and if you want more, you will have to encroach upon the space of your heavy ordnance—your only excuse for existing at all.

Up to the present, we see brought up on one side, large armored battle-ships, not only armed with guns of all calibers, but having as many as twenty and even twenty-five revolving cannons, a single

projectile from which was enough to disable a torpedo-boat, or at least to render it powerless. On these armored ships the firing may be regulated as accurately as on shore, owing to the steady platform of many of these floating masses upon a furious sea. On the other side, torpedo-boats of small size, with decks washed by the waves, with tubes flush with the water and almost constantly under it. Of course, the experiments were unsuccessful, they could hardly have been otherwise. But it might be right to suppose that things would be entirely different, if against these same armored ships were brought up staunch sea-going torpedo-boats, capable of launching their torpedoes in all sorts of weather, and scorning rapid-firing cannons, once their most terrible enemies. These small boats armed with four or six torpedo-tubes, could prove formidable against the heaviest ships. Guns of medium caliber being alone capable of arresting their progress, they would rush boldly upon the enemy, for being armed forward and on each side, they could attack under all circumstances. I insist upon broadside tubes, because they will often allow the boat to steer a straight course at the moment of the attack and under a heavy fire, and to launch its Whitehead whilst running at full speed along the enemy's side, being then at liberty to withdraw from action. At the same time, as frequently squadrons will sail in columns, or in orders derived from this, it may happen that a torpedo-boat sailing an exactly inverse course, and passing midway between two ships, will make a simultaneous attack upon the latter by firing off her torpedoes on each side. At any rate, her chances of success would be increased twofold. Will your 10, 14 or 16-cm. guns be able to sink these boats? Hardly. And I think the general opinion among naval officers to be, that the fire from ordinary guns would not be sufficiently heavy to stop the onset of a flotilla of torpedo-boats. At any rate, would not this new type of boat present sufficiently advantageous features to deserve to be given a trial? Supposing that the results would be only a little superior to those of the present torpedo-boats—a supposition that we cannot admit, by the way—where would be the harm? We would possess three or four more torpedo-boats of a heavier build, serving, according to need, as torpedo-chasers or as scouts for our fleet; they would have cost a little more money to build, to be sure, but then they could render useful service. Experiments must not be delayed; the progress of science, the requirements of modern warfare forbid delay. There exists an uncertainty in the minds of naval people;

many friends of the torpedo-boats, among the younger class especially, are still convinced of the excellency of their doctrines; a conclusion must be reached, and convincing facts be adduced by one or the other side. If this last experiment is bound to fail, as experiments will have been made with a series of vessels of increased dimensions, the rôle of the torpedo-boat will be clearly limited to coast defense, and an occasional sail on the deep, weather permitting. But just think of the grand results obtainable if we only found this desired type that is to fill all the conditions of the problem! And what facilities of construction, as a result of the limited number of adopted models!

While almost every armored battle-ship is unique in her model, and demands long years of preparation, these small boats, all similar in construction, could be built in a few months, and furnished to the Government by private industry, in time of war. For we must bear in mind that our ponderous fighting units would soon be destroyed by the enemy, whose vessels would in turn be liable to the same treatment from ours, unless they were stowed away in our dockyards. And then think of the time required to be ready; I do not mention the replacing of the vessels destroyed, that would be an impossibility, unless war were to last forever. In a brief time, then, we would be without a single squadron to send to sea. Let us then try a last experiment which cannot fail to throw light on the subject. We do not pretend in this article to propose any particular type to the exclusion of all others. We advocate a type of a sea-going torpedo-boat superior to those tried up to the present time, and nowise contest the efficiency of boats of heavier build carrying a battery sufficiently powerful to fight at a distance. What we have said in regard to the torpedo we shall say by-and-by in regard to the gun and the ram. But the same as for launching submarine weapons we desire boats of just sufficient capacity, we should also plead in favor of placing the guns, be they 24, 27, or even 34 caliber, on board vessels of smaller size than those recommended nowadays. Our efforts have been principally directed in demonstrating that it was far better to increase the number of small fighting units than to accumulate upon a single costly ship all kinds of war implements. Without going into the detail of all the advantages to be gained by the creation of these new types, we have nevertheless tried to demonstrate their importance. He who will finally plan the model ship that will justify beginning its construction at once, will have rendered his

country an eminent service. With very little effort, perhaps inside of a year, we would be the only nation in Europe ready for war, and would hold the first rank until the day when that most admirable of all the problems of the human mind, the submarine boat, the true weapon of the future, shall have been realized. But a naval power, in order to maintain its supremacy, must make use of all sorts of weapons; the ram, for instance, which when handled by an able commander may prove formidable, and guns which can be directed against an enemy's fleet as well as against a hostile coast and forts to be bombarded. In a general way these weapons go together. All vessels, capable of carrying a powerful battery, possess a large enough tonnage to be able to strike a deadly blow with their rams. But this mode of attack by shock has a great inconvenience. Just think of the enormous strain to which the ram of a vessel striking under the most favorable conditions will be subjected. In most cases the vessel struck will possess a momentum, the lateral component of the shock will therefore be enormous, and the ram being, relatively speaking, feebly supported in that direction, on account of the tapering forms of the bow, will run a great risk of being injured. The example of the Ferdinand Max at the battle of Lissa withdrawing, with but slight injury to herself, after her encounter with the Re d'Italia cannot be adduced as a proof to the contrary. The Italian ship had only a moderate speed, and vessels of that epoch were far from possessing the weight of the enormous masses that would clash together nowadays.

We think that many a ship whose ram may come in contact with an enemy's will spring serious leaks, and under such circumstances will hesitate before striking another blow. But, have we not in the Whitehead torpedo placed at the bow, a sort of detachable and renewable ram, which presents the inestimable advantage of being safe for the assailant, while producing upon the enemy effects similar to those of the shock? It is certain that at the moment of an encounter, a commander could stop his ram at about 40 or 50 yards of his adversary, or else avoid a collision by a sudden sheer, at the same time launching one or two Whiteheads, which at that distance would be sure not to miss their mark. And if the torpedo-tubes are in good condition, he can renew this manœuvre as often as his supply of torpedoes will allow—that is, four, six, and eight times. We will here remark that torpedo-boats, which at first sight appear incapable of an attack by shock, are not after all placed in a state of real inferi-

ority. It is true that there is nothing to prevent an armored ship from placing torpedo-tubes on her bow besides the ram, whilst a torpedo-boat would never think of ramming a larger vessel, and it is evident that it is better to have two strings to one's bow.

Our second type of vessel will therefore be provided with a ram of as great a resisting power as possible, and with two torpedo-tubes at the bow, the latter to be used in preference, especially against a superior adversary. This arrangement will, I think, be readily admitted by everybody. Now we come to the artillery, and will first admit this principle. The conditions of seaworthiness (buoyancy) being secured, the vessel must be of a dimension just sufficient to carry one or two guns, no more. This is necessary in order to obtain the maximum *fractionnement*, which must be realized, for the reasons already given. The vessel will be a floating gun-carriage, nothing more. She will be built for the gun, and her size will depend upon the caliber of her battery.

We have endeavored, in the beginning of this study, to illustrate the following point: being admitted that a vessel, whatever her size and power, is liable to be destroyed by one of the three weapons, torpedo, ram, or gun, it becomes imperative for that very reason to give ships the minimum dimension necessary to accomplish their work. But this dividing into small fighting units holds other advantages besides limiting the ravages of the enemy's blows. First must be reckoned the advantages in point of the number of rams to be brought into line of battle, a condition of success of no mean value.

We are convinced that in a close encounter it is far better to have at command a large number of vessels of small size, for the reason that a ram will play, if not a preponderant part, at least an important one. An enemy assailed at close quarters by three or four adversaries will find great difficulties in parrying their blows, and have very little chance to escape them. For the very manœuvre, that would save him from one foe, will often expose him to the risk of being rammed by another. We would certainly prefer in an action of this kind five vessels of the Bayard type, that do not attain 6000 tons, to two of those colossal ships like the Italia that reach nearly 14,000.

The advantage of numbers in a hand-to-hand contest will be immense, preponderant, decisive. It is in view of the attack with the ram that we should seek to realize a second condition, also of the highest importance, and which we are pleased to acknowledge has been

paramount with us; we refer to turning power, which allows, after an end-on onset, of turning round in a small circle and assailing the adversary before he has had time to perfect his change of bearing. This quality is nearly as important as speed in a large ship which is bent upon an attack, and vessels like the Italia are far from possessing it. The tactical units enable us besides to cover and watch a more considerable extent of sea, which in naval warfare is of prime necessity. It should be remembered that it was in privateering warfare that we did the English the greater amount of injury. A large number of vessels will permit us to enlarge the cruising grounds, and to stretch upon the most frequented seas a net sufficiently tight to make it difficult for an enemy to pass through unperceived.

The number of torpedo-launching tubes can be considerably increased. Each vessel carrying only one or two guns on the upper deck, all the gun-deck can be fitted with six or eight tubes—two forward, and the others on the sides. The light draft of these vessels will enable them to escape from a more powerful adversary, and also to occupy a more favorable position in a coast attack or defense. The training of the *personnel* would also be benefited thereby; the number of officers in command being greater, more of them would have an opportunity for observation, and in time of war we would have a large number who had experience in the arduous duties of a commander. Another advantage is found in rapidity of construction. Up to the last moment of her fitting out, an armored vessel is useless. If four of these new torpedo-boats are equal in men and money to a single armored ship, and one would take one-fourth the time to construct, the same dockyard and the same stock could be used successively, and thus an armored ship would be launched in quarters, so to speak. Besides, nothing would prevent their being put on the stocks at the same time, in different yards, in case of war, and they would be ready in one fourth the time. From all the reasons adduced, the maximum *fractionnement* is forced upon us.

Now, what caliber of gun must be adopted? The war in China has demonstrated the inadequacy of the 14 cm. At least 24 cm. is necessary to produce any deadly effect in land attacks, and in certain cases even 27 cm. We are not adverse to heavy guns; had we several fast cruisers armed with the excellent 34 cm. now in use in the navy, we could turn them to good account. We, as well as our neighbors, possess only a few armored battle-ships whose plates could resist the impact of the 27 cm. fired at short range. Often one

part of the ship is protected whilst another, nearly as important, is much less so. Few central redoubts would be proof against guns of this caliber. Turrets, better faced in general and harder to pierce, sometimes leave the breech and often the chase of the gun exposed; it is very probable that the heavy pieces would be injured seriously by a projectile of this caliber. There being few armored vessels necessitating 34 cm., it would be inconsistent to build many of those guns. Were they even more numerous, we would still advocate the building of guns of an inferior caliber. The ram is at hand, along with the torpedo, ready to accomplish the submarine work the gun cannot perform. It is better, we think, to resort to a different weapon than to build guns of exaggerated weight, slow in firing, and whose power is far from compensating for the cost of the ships they require. In the majority of cases, then, 27 cm. will be quite sufficient, and we would advocate three types of vessels: one carrying 24 cm., the second 27 cm., the last 34 cm., the number of the latter being relatively small. With the necessity of batteries of 24 cm. arises that of a pretty considerable displacement, certainly superior to that of torpedo-boats, for the type of vessels we are studying. But before discussing figures we should first find out what will be the other principal dispositions, such as protection of the water-line, battery, coal capacity, in order to calculate consistently the displacement of the sums of the weights assigned to each object.

It would be quite compatible with the views we have so far expressed to arm each vessel with one gun only; however, as this single gun must necessarily be placed on the deck, and as it is impossible to suppress the smoke-stack, there would be left a dead angle of about 90°. We will then admit two guns instead of one, arranged, for instance, like those of the Terrible, or else like the turrets of the Italian armored vessels Duilio and Dandolo; two high-power guns, but with the greater number of rapid-firing guns and Hotchkisses. This light artillery will be useful against small torpedo-boats like those now in the service, and in intercepting merchant vessels. The continuous shower of shot and shell that it will pour on the enemy's deck in battle will also produce a great moral effect, and carry dismay among the men necessarily exposed, like the signalmen. Many ships have besides useful organs, such as electric search-lights and divers connecting gears, that are not protected at all, and which it would be advantageous to destroy. To the two heavy pieces, then, we add machine guns or rapid-firing guns, but nothing else.

The high-power guns will be placed in closed turrets. The object being to have at command a certain number of guns, it would be better to make them absolutely independent of one another; in the first place, always according to the same principles, the loss of one gun will leave the other uninjured, and then each gun will have a firing arc of 270°, thus commanding nearly the whole horizon. A great firing arc is indeed of the greatest advantage, and a vessel armed with guns, each of which has a train of great compass, will often silence an adversary who has a greater number of pieces, but an inadequate horizontal train.

This is a twofold advantage of the turret over the redoubt, to which it will not be amiss to call attention here. Thus the plates of our largest armored battle-ships are too weak, and powerless in preventing a projectile of heavy caliber from penetrating the *blockhaus.* Just think of the horror and dismay resulting from the bursting of a 34 cm. shell in a central redoubt. Two or three guns may be disabled at one blow, and those of the gunners who may escape the numerous fragments of shell and plates will hardly resist the high temperature caused by the explosion.

The turret affords, besides, a better control, and its fire will be all the more dangerous, as it can be made more plunging. Finally, the turret is better protected against the action of the sea, and its circular form presents only one point at which a shot can strike it about normally.

The turret, therefore, will be selected, and protected heavily; we would not consider a 40 cm. steel plate excessive. The turret will move with the gun so as to be entirely closed. In case of an injury preventing its revolving, a special device will make the movements independent. To do this, the gun will be mounted on a platform with slide rollers, secured to the turret cover. A simple lift by means of hydraulic apparatus will clear the chase of the gun in the cylindrical part of the turret, and the same gear that turned the whole will revolve the gun and cover alone, leaving the turret still. The deck will be perfectly flush, with the exception of the line of the two guns, where stand the smoke-stack and the one mast or two masts used for signals. A protective steel deck of 10 cm. maximum, under which will be fitted a splinter netting, will extend the whole length of the ship at nearly five feet below the water-line; its shape shall be somewhat convex in order to afford more room for the engine. Above this protective deck, a wide cellular belt will gird the ship up

to at least 20 inches above the water-line. At this height there will be an upper deck of very light sheet-iron, and the whole space between the two decks not filled with cellulose, with the exception of the necessary narrow passages, will be divided into numerous compartments by longitudinal and transversal bulkheads. Each of these little compartments will be a coal bunker. Under these conditions, a shot penetrating at the water-line will at most flood only a few of these cells, and one of two things, either they will be filled with coal, and very little water will enter, or else they will be empty in consequence of expenditure, and the vessel off trim from loss of a given weight, in which case she will recover her load-lines with the influx of water. In either case, the invariableness of stability is secured. The only inconvenience will be that the available coal will be reduced, at least momentarily, by the quantity in the flooded cells. The turrets and protective decks will be connected by armored passages for powder and projectiles.

The essential organs, *i. e.* the helm, the gearing, the speaking tubes, will be protected in an absolute manner; the commander will have his armored conning tower in a favorable position. There the helm and speaking tubes will be perfectly safe; the apparatus for aiming torpedoes may also be placed there, or will have a well protected redoubt of its own. All the gearing, speaking tubes, etc., will go directly from the conning tower down below the protective deck, so as to reduce to a minimum the dangerous part of their course; a heavily armored passage will insure their immunity from injury. Too many precautions cannot be taken for securing constant communication between the commander and the vital parts of the ship, the helm and the engine. Perhaps the best way of obtaining this result would be to adopt for all transmissions of orders, electric apparatus, which can certainly be done, and to multiply the wires; these questions of detail may at certain moments acquire a capital importance.

On the gun-deck will be placed the torpedo-tubes, two meters at least above water, so that the latter will not interfere with their launching. Sufficient account has not been taken of this condition of elevation in building most of our torpedo-boats; it was a great mistake, and we recognize it now. Above the protective deck there will be, as already stated, an orlop deck (*faux pont*) of light sheet-iron, raised somewhat above the water-line, 20 inches, for instance. This deck will form the floor of the torpedo battery, and by raising the tubes above it some five feet, a sufficient elevation will be obtained.

With a height of 2.50 m. under beam and the 2 meters of the turrets, the guns will be placed more than five meters above the water, which is quite sufficient, the more so as the turrets are closed, and the pointing will be done from a conning tower (*blockhaus*). It would be even possible to reduce this height considerably, if it were found to interfere seriously with the ship's stability.

It would be desirable to have the tubes protected against the fire from machine guns; on the other hand, it is necessary to avoid increasing the weight of the ship, and a splinter-netting on the gun-deck to offset the destructive effect of the projectiles will be sufficient. A belt of coal 2.50 m. high, and as wide as possible, encircling the ship, gives a relative protection. Besides, in the rear of the bow tubes, a transversal coal bunker two meters thick at least, that must be left untouched as much as possible, will partially protect the battery against an enfilading fire which might work disastrous results. To use the coal necessary for the engine as a bulwark of protection is assuredly an economical solution of the question of weights and a very satisfactory one.

It is seen that the coal-carrying capacity is great; as a compensation, a great economy will be made in stores and supplies. It seems rather inconsistent to have three months' provisions, and coal only for a week; such, however, is the condition of things on board many vessels. It would be preferable to be provided with a little of everything for an equal length of time. Economy in weight must be carried to its utmost limits. Everything useless must be avoided. The least possible number of boats must be assigned to the vessel, except in time of peace or on a special occasion, when they will hang from movable davits. Only two small anchors will be used, such as Martin anchors, for instance. The masts, two in number at most, and very low, will be of steel. The exclusive use of steel is demanded as much because of diminished weight as to lessen danger of fire. We think that wood should be entirely excluded from the ship, even from the rooms of officers. The risks from fire are already too great, and if one should break out in the midst of battle, we would not know against which enemy to turn.

It is evident that the greatest solicitude should be directed to the motive-power. The engine, packed as snug as possible on account of the lowering of the protective deck, will benefit by all the weight economized in suppressing the armor plates at the water-line. It is unnecessary to dwell on the advantages of speed, this is too well

understood nowadays. To be able at will to offer or refuse battle is half the victory. In order to obtain at the same time great turning power, there will be two screws, each operated by a separate engine. As a matter of course, water-tight bulkheads will be as numerous as possible. Thanks to the preceding arrangements, the greater portion of the *personnel* will be perfectly sheltered. Below the protective deck, in the engine and fire rooms, the torpedo and the ram alone will be able to make a breach; no human device can avert their blows. The guns and their crews will have adequate protection; the torpedo artificers will possess a relative security, and will be safe from the fire of the Hotchkiss gun.

It will be noticed that owing to the general arrangement of guns and torpedo-tubes, the latter can be fired under all conditions, without hindrance from the blast of the heavy pieces; whereas on board of more than one of our large battle-ships, the reverse is often the case.

The masts will be surrounded with a spiral staircase, armed with the Hotchkiss or rapid-firing guns protected against musketry. The latter will be done away with; it takes three men to work a revolving gun which pours forth a continuous stream of shot and shell, and three men represent only three muskets. There is therefore an overwhelming superiority on the side of the Hotchkiss, and as the gun is light and small, its use can be multiplied; musketry must give way to it entirely.

What will finally be the tonnage of a vessel of this class? Is it possible to reduce to that extent the size of our large battle-ships, whilst preserving to them the sufficiently powerful means of action we have just enumerated?

Before everything, the vessel must be seaworthy. Let us pick up examples among the list of our fleet. After the large battle-ships of the first class, displacing 10,000 and 11,000 tons, come those of the second class, like the Bayard, Duguesclin, and Turenne, of 6000 tons. Next in order come the Triomphante type, with a displacement of 4100 tons, and finally the old armored vessels of 3000 to 3500 tons, quite large enough to keep at sea in all sorts of weather. They have given sufficient proofs of it in distant parts of the world, for they are armored cruisers. Let us stop here. In the first place we will state that we take these vessels only as samples of seaworthiness, for they are entirely too antiquated.

With the saving in weight resulting from the substitution of steel

for wood, the doing away with the redoubt and the armored belt—in fact, by carrying out the plans we have described above—we are convinced that with a vessel of 3000 or 3500 tons displacement we would realize the class of vessel desired. This vessel could carry two guns of 34 cm., and would prove, I think, sufficiently seaworthy.

Is it possible to decrease even that tonnage? Here we have, among the large cruisers, the Iphigénie, which displaces only 3200 tons, the Duguay Trouin, 3300 tons; the Lapérouse, Magon, etc., 2200 tons. These are still pretty fast vessels, averaging fifteen knots, and are very good sea-boats. They are armed with fifteen pieces of 14 cm.

A vessel of that size (2500 tons) could carry two guns of 27 cm. Lastly, a third type would carry two 24 cm., with a displacement of about 2000 tons.

Notice that the Fusée, which carries one 24 cm., displaces 1045 tons; the Achéron, which carries one 27 cm., 1639; it is unnecessary to add that the displacement of a vessel is not increased double because the armament has been doubled. If a 1000 tons vessel is able to carry twenty-fours, it proves that she possesses sufficient resisting power against the fire of that caliber, and there is the whole question. The addition of a new gun would only increase the displacement by a few hundred tons at the utmost. Two thousand tons, and especially three thousand, is a great deal indeed, and it is to be much regretted that a smaller displacement is impossible. However, we think that our figures are pretty correct, and that a vessel strong enough to carry heavy guns, and at the same time to challenge all kinds of weather, can be small only relatively.

Well, let us compare a squadron of these new fighters with our Mediterranean training squadron, for instance. We have:

				Heavy guns.
Amiral Duperré,	4 guns of	34 cm.		4
Courbet,	4 "	34 cm.	and 4 27-cm.	8
Dévastation,	4 "	34 cm.	" 4 27-cm.	8
Colbert,	8 "	27 cm.		8
Redoutable,	8 "	27 cm.		8
Terrible,	2 "	42 cm.		2
Indomptable,	2 "	42 cm.		2
				Total, 40

The respective displacements are approximately:

Amiral Duperré, .	10,500 tons.	Redoutable, . . .	8,800 tons.
Courbet, ...	9,600 "	Terrible, ...	7,200 "
Dévastation, . .	9,600 "	Indomptable, . .	7,200 "
Colbert, ...	8,500 "		

Taking fifteen millions of francs as the average cost of each of these—and it is not exaggerated—we have then spent 105 millions to put afloat 61,400 tons and 40 pieces of heavy ordnance.

The same displacement represents to us 20 vessels of 3000 tons each, also carrying 40 heavy pieces, for nearly the same price.

We would therefore possess all the advantages enumerated above without paying one cent more; and surely far more reliance can be placed in the twenty vessels fitted with rams, than in the seven of our present squadron. No doubt the Courbet is a superb vessel, but let a 34-cm. shell burst in her redoubt, and at one blow a considerable portion of her battery will be put *hors de combat.* The Dévastation is the exact counterpart of the Courbet. This is still more true of the Colbert and Redoutable. As to the Indomptable, the Terrible and the Duperré, their enormous guns are protected very little or not at all; the carriages alone are sheltered; and, as we have already stated, a moderate-sized shot striking any of these pieces would be very likely to disable them. It was owing to the overweight of the armor at the water-line that full protection could not be given to the guns. It is to this same armored belt that are due all the other defects of our vessels, as want of speed, and inadequate coal-carrying capacity.

The vessels we propose, having a light draught and great speed, could seek safety in flight in case of inferiority; but on the day when they were in sufficient number, they would advance boldly to the combat, accompanied by their smaller escorts, the torpedo-boats.

We have selected three types of somewhat different dimensions, carrying respectively 34, 27, and 24 calibers. Does it mean that our light batteries will become useless? Not absolutely so. It is not enough to assail the squadrons of the enemy, we must also destroy his commerce. We have already stated that our experience in China has taught us that in order to attack large vessels or land fortifications with any show of success, we must not make use of a caliber inferior to 24 cm. The intermediary pieces of 19 and 16 cm., too powerful against a defenseless enemy and too weak against large battle-ships, should be laid aside.

It remains, then, to determine the type of the vessel carrying 14 cm. intended for cruising against merchantmen. We will still pursue the same way of reasoning, but we do not here reach the same conclusions. A vessel able to carry only two guns of 14 cm. would be

of too slight scantling, and it must be remembered that seaworthiness is the first condition. Now, when discussing torpedo-boats, we settled upon a figure somewhere between 400 and 1000 tons, let us say 700, for the sake of argument; we will thus commit only a trifling error.

The vessel carrying 14 cm. will have to be somewhat larger than the torpedo-boat, but must not exceed a maximum displacement of 1000 tons. She will also have a protective deck, the only difference from her smaller companions consisting in the number of guns of 14 cm. she will carry, three or four at least. The guns will be mounted on deck in light turrets, and so arranged as to fire ahead as much as possible. We are prepared to accept the plan of the Amiral Duperré, with slight modifications in the arrangements of the turrets which would allow three guns out of four to fire directly ahead, which is natural, considering that these vessels are built for the special purpose of chasing others. The steel plating of the turrets will be of sufficient thickness to resist shots from quick-firing machine guns, and even 14 cm. caliber, with which many ocean steamers would be armed in time of war. Besides the above battery, the armament would comprise the same apparatus for discharging torpedoes as the torpedo-boats, so that these vessels would serve two ends.

This is only natural, since their tonnage would differ very little, and they would carry in excess of their companions only an auxiliary light battery. As is the case with torpedo-boats, a maximum speed will be sought in preference to everything else. Intended to fight in single combats, and scattered over distant seas, these vessels may find themselves exposed to dangerous encounters, which they must be able to avoid by rapid flight.

Resuming our project, we will then have:

1st. Vessels of 3000 to 3500 tons with protective decks, carrying each two guns of 34 cm. in armored turrets.

2d. Vessels of 2500 tons with protective decks, carrying each two of 27 cm. in armored turrets.

3d. Vessels of 2000 tons with protective decks, carrying each two of 24 cm. in armored turrets.

4th. Vessels of about 800 tons with protective decks, carrying each three or four guns of 14 cm. caliber, in turrets protected with light steel plating.

5th. Torpedo boats of about 500 or 600 tons, perhaps even 700, with protective decks.

All these vessels are built according to the same ideas. All can contribute towards the same end. Those carrying heavy batteries, intended more specially to destroy hostile fleets and fortifications, can render all kinds of services and give chase to fast mail steamers, since they will have great speed.

The two inferior classes of vessels can both chase merchantmen and act as torpedo-boats in battle. Forty vessels carrying heavy batteries, six armed with 34 cm., seventeen with 27 cm., and seventeen with 24 cm., would replace with advantage and economy the twenty-odd armored battle-ships that could be put into line in the month following a declaration of war. With these forty vessels we would have an effective control of the Atlantic and the Channel as well as the Mediterranean. As to the last two classes, their number would greatly depend upon the resources of the Treasury, but should never be less than 100. Double that figure would be about sufficient to meet any emergency. Of course, we could not obtain this desideratum at once, on account of the vast outlay of money it would take to restore our *matériel*, but we may cast aside in new constructions all vessels not closely connected with one of the types or classes mentioned. And, then, let us begin with the most urgent point. We have heavy guns carried by armored battle-ships; but we are deficient in light and fleet vessels, cruisers carrying 14 cm., and above all torpedo-boats: this is our weak point, it may give us a sudden ascendancy, or it may precipitate our downfall. And the construction of these light (fast) vessels becomes all the more urgent that they are the very class we will most stand in need of in case of war with England, an eventuality which must always be considered in discussing naval questions. In a war with Germany our fleet would be powerless towards reaching a solution. It will be on the banks of the Rhine that the great game will be played, and the loss of one or more ships would only be so many drops in the ocean. Even with Italy the part played by the navy might not be decisive, whilst with England it would be quite different; to make an attack on her commerce would be to stab her in the heart. But in order to do this we want a great many fast ships, and this is the first want to be supplied.

Before finishing we will make a few reservations in regard to ordnance. New improvements being made every day by science, we do not absolutely favor one caliber above another. It is possible that in a more or less near future the 34 and 27 cm. may be dis-

carded to make way for smaller calibers, but having far greater initial velocities; but our type of vessel will vary very little, for if the caliber of a gun decreases while the initial velocity at the same time increases, the total weight must remain about the same.

The 14 cm. might be replaced by rapid-firing guns similar to the four 13 cm. delivered lately by Armstrong to the English Government.

While some modifications may take place in the minor details, the principal features will remain unchanged.

We will have to beg for a little indulgence on the part of professional men, who know how difficult it is to assign a tonnage to a vessel of an entirely new design and minimum displacement. If experience should demonstrate that it is impossible to come down as low as 3500 tons for a vessel unprotected at the water-line, but carrying 34 cm. calibers, if it were found necessary to increase somewhat the displacement, one fact would still remain clear, and that is that the actual dimensions can be considerably reduced and capital changes made.

Finally, we would like to refute in advance an objection which will not fail to be brought against us. We will be criticised for sending out to distant seas vessels armed with a few 14 cm. only, and incapable of offering resistance to a moderate-sized enemy. Similarly, one of these 3000 tons vessels meeting an armed battle-ship would be placed under a great disadvantage. We will remark in the first place that our small cruisers, with their appliances for discharging torpedoes, their protective decks and cellular divisions, will be more than a match for larger cruisers not fitted with the same appliances; and this is the case with the majority of vessels in foreign navies, as well as in our own. We find consolation in the fact that on distant stations where we keep so many old-time tubs, we meet many vessels flying the English flag that are no better.

Finally, when one is too weak to be able to cope successfully with an adversary, he must seek safety in flight. This will often be the case with our little cruisers, who will be bound to avoid an action whenever they are not sure of coming out victorious. Their object will be the destruction of the enemy's commerce, and putting aside all chivalric notions, they will attack the weak and shun the strong. This may not be generous, but it is practical, and it is in this light that we must view it. Then again, ships armed with heavy batteries will sail in groups as long as the hostile squadron is not destroyed, for their object is to try and crush it the moment they come up with it.

Besides, the best argument of all is the following: vessels of the class we propose can always keep together, for no bad weather can disperse them; then they can also sail singly, whenever they see fit.

For our part, we feel convinced that the nation who will first resolve upon this new and promising course of dividing into small fighting units, will in a short time obtain the supremacy of the sea. Our only hope is that France may not some day regret having delayed too long in adopting it.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

NAVAL ADMINISTRATION.

By Rear-Admiral S. B. Luce, U. S. N.

DISCUSSION.

Rear-Admiral E. Simpson.—Admiral Luce has given us a useful résumé of Naval Administration, and in that division of his paper where he writes under the head of "Board of Navy Commissioners," he fixes the point from which we must take our departure. The formation of that Board was, as he shows, in harmony with the results of many years of English experience. It is the proper starting point from which to consider the subject, for it was found to be very successful in fulfilling the requirements of administration that were needed for the developments of the day of its usefulness; the members of the Board discharged ministerial duties in the office of the Secretary of the Navy, under his superintendence; the Secretary had the benefit of the best professional advice. As the Secretary was supreme in both the civil and military branches, so his assistants were required to act in both capacities; and as naval ideas had not, at the time of the formation of the Board, been influenced by the coming wave of progress, a certain amount of simplicity obtained in all the details of practical work which did not demand the aid of specialists. Steam was not dreamed of as a motor for fighting ships; artillery was of a very simple character; the construction and sailing of wooden ships were the main objects to occupy the attention of the Board, and the practical knowledge possessed by the distinguished men who were from time to time ordered to perform the duties of Commissioners sufficed to fill the bill.

But the vicious combination of civil and military duties necessarily became apparent as time went on and the influence of progressive ideas was felt. The Board was required to attend to the procurement

of stores and materials, a labor in itself sufficient for one office; but in addition to this, it was responsible for the construction, armament, and equipment of vessels of war. In view of its responsibility in the matter of construction, plans for ships recommended to be built had to be submitted to the Commissioners, and their interference and arbitrary action in cases of this kind had much to do with the change of system that was made in 1842. I well remember an instance of this kind which was agitating the Department at the time of my entrance into the Navy in 1840. The first ship that I served on was the Decatur, a third-class sloop of war, as she was called. She was one of four new ships; the Marion, the Preble, and the Yorktown being the other three. These ships had been designed by the Naval Constructors, but when the plans were submitted to the Board of Navy Commissioners, they arbitrarily cut off ten feet of the length, and the constructors were forced to build the ships on these changed proportions. The Constructors of the Navy, as the constructors out of the Navy, were leading the modern ideas in the way of progress in this most important branch, and this error of the Commissioners went to show that the time of the usefulness of the Board was past—that it was an obstacle to development. It was this mistaken interference with the civil branch of the Department which hurried up the abolition of the Board of Commissioners, and the substitution of the bureau system. The action of Congress resulted in removing from the office of the Secretary all ministerial assistance, depriving him of all professional advice in the military and disciplinary branches of his duties, and in establishing certain bureaux, among whom he could distribute such of the duties of the Department as he judged to be expedient and proper.

The great blunder in this action was that it was too extreme. The object was to provide the Secretary with aid in the civil administration, secure against the interference of military control; but the necessity of professional aid in the other branches was ignored. The position of affairs is this: the Secretary is the sole representative of authority, and the chiefs of the bureaux, his aids in civil administration, are his appointments and can be virtually removed at his will. In military matters he stands alone, without advisers. He is absolute in the control of all branches. No official position in the country embodies such absolute authority and so much personal responsibility. This is the position of our Naval Administration. It cannot produce the best results.

There is much to be said in favor of one-man power; on board ship it will hardly be questioned that absolute authority must be vested in the commanding officer, but the commander is fitted by his training and experience to direct intelligently all branches in his command. This knowledge can hardly be expected of a civilian placed in charge of the Navy Department. There have been two instances where the Secretary of the Navy had previously occupied important positions in the Department, and their familiarity with its workings had much to do with the successful manner in which the executive duties of the office were performed during their incumbency; they were able to go into any bureau and direct the chiefs in details of business matters; but even these still lacked professional counsel in military matters. Since the establishment of the bureau system the Secretaries have generally referred for professional points to such line officers as happened to occupy positions as chiefs of bureaux, though such occupation was foreign to the duties of the office they filled. The officer holding the position of Chief of the Bureau of Navigation has generally been most consulted in this way, and to his bureau has been delegated for many years the important work of assigning officers to duty, and preparing instructions for cruisers, besides other executive work totally foreign to the primary work of the bureau. The Bureau of Equipment has charge of the enlisting of men and of the training of boys, work which is entirely military in its character, and this, as the assigning of officers to duty, is something outside of bureau jurisdiction.

The fact of the Secretary being forced to go to chiefs of bureaux designed for civil administration, for aid in military matters, shows the necessity of military advisers, apart from the civil, and that the present establishment is deficient in not providing them. Taking the law as it stands, I see no reason why the Secretary cannot appoint officers to take charge of the military branch, as advisers to him, even though such a board is not established by statute. This board would relieve the Bureau of Navigation of all matters not consistent with its title, and would put the Bureau of Equipment out of commission, as all the work now done by it, apart from enlisting men and training boys, can be more appropriately perfromed by the bureaux of Construction and Finance.

With the establishment of the Military Board, the Bureau of Yards and Docks can also be dispensed with. All ships, when not under construction or repair, are under the control of the military branch of

the Department, and must be guarded and cared for by those who exercise military authority. They come under the supervision of those charged with executive control and the administration of naval discipline, the source of which, under the Secretary, is found in the Military Board. In reference to care of the yard, this is necessarily under the control of the commandant, a military officer exercising control over all branches of his command, with authority to utilize the means and to direct the services of all the bureau representatives. The commandant of a navy-yard is in his sphere the representative of the Secretary in both his civil and military capacities, and there can be no necessity for an additional authority to direct matters in the yard itself. This duty will naturally be delegated to the captain of the yard, who will have his orders from his immediate military commander.

As to the question of docks and wharves, they naturally belong to the Bureau of Construction. As far as relates to docks, it may be asserted that virtually they are under control of the Construction Bureau now, and by turning over to it the building, repairing, and caring for wharves, its duties will not be seriously increased, and such a transfer will save the expense of plant, etc., for an extra workshop. There may be from time to time some engineering work required in a navy-yard, when a civil engineer may be engaged on contract, or a civil engineer of the Navy may be stationed at the yard under the orders of the commandant.

I assert, then, that with the establishment of the Military Board in the Navy Department, the labor can be more appropriately apportioned among the bureaux than it is now, and that two bureaux can be put out of commission, with the advantage of increased facilities for work and reduced expense.

My proposition, then, is, 1st, to remove from the Bureau of Navigation all work not legitimately classed under its title; especially must it be relieved of the roster of officers, and exercise of executive authority over ships in commission. All work of a military character should be transferred to the Military Board.

2d. I submit that the Bureau of Equipment be abolished, transferring to the Military Board the enlistment of men, and all matters relating to enlistment and training of boys; to the Bureau of Finance and Supplies, the purchase of coal for the Navy; and to the Bureau of Construction, all other matters under its control.

3d. I submit that the Bureau of Yards and Docks be abolished, the

military and executive control of the yards being transferred to the Military Board, and all matters relating to docks, wharves, etc., being transferred to the Bureau of Construction. If considered necessary, a Navy civil engineer may be permanently or temporarily attached to the staff of the commandant of the yard, or contracts may be made for special work with a civil engineer not in the Navy.

As the assignment of ships for service will come under the direction of the Military Board, it will be necessary for it to be informed from time to time of the progress of work on ships under construction or repair, condition of batteries, engines, boilers, electrical apparatus, etc., all which information should be given by the bureaux when requested by the Board; but the Board can exercise no authority over any bureau, the Secretary of the Navy retaining the sole authority to issue an order to a chief of bureau.

Three line officers of high rank should constitute the Military Board, to be appointed by the Secretary of the Navy for a term of three years, and to be removed, relieved, or reappointed at his pleasure, thus removing all danger of injury to the service by serious difference of opinion between the Secretary and his counsellors. The responsiblity for all rests with the Secretary, and accord with his counsellors is necessary to justify him in assuming the responsibility of following their advice.

What I have said may, I think, serve as a basis to act on—as a first draft of a plan to be discussed, elaborated, or remodeled. It establishes a Military Board, and redistributes the assignment of Department work. I now propose a method by which the work of the bureaux controlling the civil work of the Department may be coordinated.

My views on this matter are formed on the experience I had as President of the Advisory Board charged with the construction of the first four vessels of the new Navy. This Board consisted of the president, a line officer; two engineers, one a civilian; two naval constructors, one a civilian; two line officers, and a secretary (a graduate of the Naval Academy, with rank of Assistant Naval Constructor, well informed on engineering matters). The new ships were designed by this Board, and it had charge of all the details of construction. This Board sat daily, in daily correspondence with its inspectors at the yard of the contractor and at the foundries where the material was being manufactured. Matters relating to all branches, whether of construction, of steam engineering, of platforms for batteries, of

position of dynamos or boats, of ventilation, of strength, of metal, or of domestic arrangements, were all discussed by the whole Board, and wherever the work of one branch was found to be interfering, or likely to interfere, with the work of another branch, the difficulty had to be settled there and then, so that the mail of that day might instruct the inspectors. The representative of each branch on the Board was loth to modify its plans, but the matter could not be avoided or postponed, it had to be settled at once. Thus compromises were forced, and these were mainly arranged by the members whose specialties were not concerned, but who were familiar with the needs of all. The representatives of the different branches were thus forced to "co-ordinate," as a majority of the Board, when a vote was taken, decided the question.

My proposition is that the chiefs of bureaux—not all, but such as have to do with *matériel*—should constitute a permanent Advisory Board, meeting daily and discussing all matters relating to construction of new ships, repair of old ones, arrangement of batteries, etc., with view to making all their plans co-ordinate, by controlling weights, and watching carefully that no departure be made from the original plans or designs without the accord of a majority of the Board. All new ships should be designed by this Board, and every detail of construction followed by it; and all reports from constructors at navy yards, as well as from the inspectors at the yards of contractors, should be received by this Board, discussed, and action decided on before they go to the bureaux. Each bureau will thus be under control of the Board which is composed of their respective chiefs, and there ought to be no danger of complication in the progress of the work.

The antagonism which existed in the Navy Department to the Advisory Board arose from the feeling that it was exercising the functions of the bureaux. The fact that it existed by act of Congress was not sufficient to reconcile the bureaux to its existence. There was no harmonious action, and such aid as was required of them was not readily or willingly rendered. The Advisory Board will go out of existence with the completion of the Chicago, and that injury to the *amour propre* of the bureaux will be removed, as its duties were limited to the first four ships.

But the bureaux have the same cause of complaint now as regards the designing, at least, of the new ships that are under construction. In the case of those vessels, boards have been formed, under the Secretary's order, to devise and submit plans to him; the bureau chiefs

are thus subjected to the same slight at which they so chafed in the case of the Advisory Board established by act of Congress.

If the chiefs themselves are required to act as members of a permanent board, there ought to be no antagonism with anybody. No chief will be entirely independent in control of his work in his bureau, as in work where other bureaux are concerned he must work in accord with them. But the same consideration must be exercised by the other bureaux in reference to him, and thus the *quid pro quo* will be rendered.

I should look for the best possible results to follow from this daily intercourse of the chiefs of bureaux. Each bureau is seeking and acquiring the latest information in respect to developments in its branch. The Office of Intelligence is engaged in collecting information on all professional subjects, and the fruits of its labors are at the service of the Board. The collections of each being communicated to all the members will keep them *au courant* with general progress, and no body of men can be found better equipped to advise on matters of new construction. The full benefit of all their research can only be gained by mutual counsel, imparting information one with another, and thus "co-ordinating" their labors.

Experience has shown that if this matter of meeting for consultation be left to the discretion of the chiefs of bureaux, nothing will come out of it. They are very sensitive to any interference with their prerogatives, and are unwilling to accept suggestions except from their own corps. If it were possible to secure sufficient time for Congress to act on Naval Administration, it would be well to have these consultations of the Board established by statute, and at the same time an assistant chief should be provided for each of the bureaux whose chief is a member of the Board. From my experience on the Advisory Board, I have seen that the work of the Board will occupy a large portion of the labor of its members, who will be prevented from attending in the bureau office for the dispatch of current work. This must be turned over to the assistant chief, in accordance with the decision of the Board, communicated by the chief himself.

This Board should consist of the chiefs of Construction, Steam Engineering, Ordnance, and Navigation. The president of the Board should be a line officer of high rank, selected for his known familiarity with matters of construction and *matériel;* and a secretary should be appointed from the lists of assistant naval constructors or assistant engineers, young men who have shown decided ability in their pro-

fession, and familiarity with the higher studies of designing ships and engines. The president of the Board, not being a chief of a bureau, will be more apt to insist on the thorough discharge of the work of the Board than if he were a chief of bureau, and his influence as a moderator will tend much to modify serious differences of opinion by suggesting compromises.

I would leave the Bureau of Provisions and Clothing, more properly to be called the Bureau of Finance and Supplies, under the personal control of the Secretary of the Navy. In matters pertaining to this branch of Department work, the chief of the bureau is the all-sufficient adviser to the Secretary. As this bureau has now all disbursements under its control, purchasing all supplies as well as distributing the "pay of the Navy," I would limit the responsibility. The Secretary may naturally be supposed to be a man of business ability and of some legal knowledge, and in affairs of finance should personally assume the control that is imposed by the responsibilities of his office.

The Bureau of Medicine and Surgery I would also leave under the personal control of the Secretary, except in the assignment of officers to duty, and employment of *personnel*, which would be a part of the business of the Military Board.

These, in brief, are the ideas I would suggest for the distribution of the work of the Department. It remains to cite the portion of the labor that would come under the supervision of the Military Board, to which I would add the Commandant of the Marine Corps, when matters relating to that military branch of the service are under consideration.

The Board will consist of three line officers of the Navy, carefully selected for fitness, of as high rank as possible, none to be below the rank of commander, and the Commandant of the Marine Corps, when that branch of the service is under consideration. One member of the Board shall be selected for his especial acquirements in the branch of naval gunnery. The president of this Board will be the Secretary of the Navy, when his other occupations will admit of his attending the meetings—at other times the senior officer will preside. All orders issued by this Board are supposed to emanate from the Secretary of the Navy, and will be signed by him, or, under instructions from him, by the senior officer, "by order of the Secretary."

Under its control will be placed all that relates to the *personnel* of the Navy, officers, enlisted men and boys, and the Marine Corps; all that relates to ships not in the hands of the bureaux under construc-

tion or under repair, their efficiency if in commission, their care and preservation if in ordinary or waiting assignment to sea duty; the instructions issued to commanders-in-chief, to commanders of ships and commandants of yards; all matters relating to discipline, court-martials, reports of punishment, etc.; all matters relating to military exercises of all kinds, whether with sails, guns, boats, landing-parties, or what not; all matters relating to naval gunnery, as distinguished from ordnance; the office of Naval Intelligence, and the office of the Judge Advocate General.

These duties are of the most important executive character, involving much labor. It is evident that the services of several junior officers will be required to attend to the details of work assigned to the Board. This work will be highly instructive to those who may be charged with this duty.

Believing that the Secretary has the authority to make such assignment of duties as I have indicated, I would point to the advantage thus granted of trying the experiment before fixing the rule by statute. Such inconsistencies as might become apparent by practice could be corrected and the whole adjusted on a working basis, and when perfected, an act of Congress might be asked for making it law. Meantime the two bureaux to whom no duties would be assigned would await eventualities, and their abolition by legal enactment might be declared at the same time as the new law is confirmed. They exist now by law, but only for the convenience of the Secretary if he wishes to assign duties to them. There is nothing mandatory in the law, making it necessary for him to employ them; if he prefers to divide his duties without their use, they are simply in abeyance and superfluous.

What I have said agrees in the main with what has been advanced by Admiral Luce, but we have different ways of reaching the same end. As an officer of the Navy, I am much obliged to him for having started this "ball in motion," and if he finds he has roused the "jeers and taunts of his opponents," he will see that I am not one of them. I hope his paper will attract the attention it deserves, and that it may lead not only out of the Department, but in it as well, to serious thought, and ultimate deliberation in council, by which means alone a final decision may be reached which can be approved by the sound judgment of the Navy.

LIEUTENANT RICHARD WAINWRIGHT.—The most valuable portion of the paper under discussion is "the principles which should

obtain in the organization of a naval government," as deduced by Admiral Luce from his historical account and graphic description of the English, French, and our own naval administration. Certainly there can be no subject of greater importance to the Navy. If our naval administration is faulty, it must affect the Navy to its very core, especially at a time when, under the best of government, its entire organization must be on the stretch because of the great changes being made in its material, and the necessity of keeping going at the same time a very old Navy and a very new Navy. How can we tell if the present system be faulty or no? At first sight it would seem as if the test of war were the only true test. In a naval establishment this is not altogether true, but as it has been claimed that our present system stood the test of war, it may be well to look into the matter. Admiral Luce shows in his paper how, "under the pressure of a great national crisis, the Department changed its organization in the direction suggested by theory, only to relapse when the pressure was removed." But how was it before the organization was changed—that is, before Captain G. V. Fox was appointed Assistant Secretary? Certainly the Navy was not in any way prepared for war. It might well have been that under any system the Navy, at the outbreak of war, would have been unprepared so far as ships and guns, as the material goes; but look at the workings of the Department itself. The Secretary had no one to turn to for advice; none whose duty it was to tell him what operations might be undertaken, what was needed for the successful accomplishment of the objects of the expedition. To be sure there were people in the Department whose duty it was to advise him as to various minutiae, mainly in regard to the material; but no one to tell him what the Navy could do, and what was impracticable, and in fact to give him advice as to naval policy, naval strategy, naval tactics or logistics. Captain Fox did much to supply this need. He was a highly intelligent man, a very able officer, with fine executive ability, but he could not supply the want in the system at once. Much of the information needed he was obliged to gather amidst the pressing necessities of a great naval effort. No one but himself can tell how hard this was in the commencement, or how much energy he was obliged to expend in overcoming the inertia of an old and faulty system. We know that the Secretary, Mr. Welles, found advisers, and chose his men well; but, in the nature of things, they could not supply altogether and immediately the much-felt want. We have seen in the history of Abraham Lincoln, by Hay and

Nicolay, who some of his and the President's advisers were, and to the names of Fox, Meigs, and Porter might be added the names of Professor Bache, the Superintendent of the Coast Survey; and the then Hydrographic Inspector and afterwards Superintendent, Carlisle Patterson, once an officer of the Navy—all able men, all able advisers, but none directly responsible for their advice; none with plans prepared beforehand; none with the necessary information—nor was there the necessary machinery in the Department to carry out the best of plans. The plans were various; they were pushed forward to a great extent by personal exertion. They interfered with each other; and so faulty was the machinery, that an expedition, approved and authorized by Mr. Welles, was prevented from being a success by the diversion of some of the vessels needed, without the Secretary being aware of the change of destination. The Navy during the war met with many successes and achieved wonderful results, but in spite of the bureau system and not because of it. It is difficult to judge of the efficiency of a naval or military system by success or failure in war. In time of war, great men, men of genius, come to the front and trample down all obstacles, and the blood and money of the country run as water. It is only by noticing the obstacles that are overcome, and seeking the cause of failures that do arise; by careful observation of the workings of the system itself, as separated from special change made under pressure—that the faults of a system may be discovered, though the war be successful. The same argument was used, prior to the Crimean war, in favor of the military administration of Great Britain. It was urged that under this administration, Napoleon I was conquered by Wellington. Kinglake shows how the administration altered under pressure, and thus altered, served to enable Wellington to conquer; and he also shows how it again fell into old grooves and became so wedded to them that it failed to yield to pressure in the early part of the Crimean war, and thus produced the horrors, the crimes of that first winter, and nearly brought about the overthrow of the English, and thus of the allied armies. It is to be hoped we may not need such a lesson to force the adoption of needed reform.

Admiral Luce has sounded the keynote of our necessities, the separation of the military from the civil business of the Department. If any one doubt this, let him look for any definite naval policy under the present system. Surely a naval policy is necessary during the formation of a Navy, so that the class and number of vessels to be built may be decided upon, as well as afterwards, for the wielding of

the power formed. Under what bureau of the Department does naval policy come? Whose duty is it to advise the Secretary as to the policy to be adopted, and place before him the data necessary for him to reach a conclusion; to inform him of the various kinds of policy, and the material needed according to the policy he may adopt? Surely this alone requires much machinery to gather the necessary information, and long study to digest it, an active naval career to prepare for its understanding. Above all, who is required by authority and custom to place before the country the outlines of a scheme for building up the new Navy, and for its proper use after it is built? What is our policy? Surely not one of offensive war, for we are not beginning to think of building a Navy that can keep the seas. Not a defensive war, for we have not thought of building the necessary torpedo-boats and coast-defense vessels or a flanking fleet. In fact it has not been decided what part the Navy would take in a defensive war; whether it would be a better defense to rely on fortifications aided by torpedo-boats and a few harbor-defense vessels, or combine fortifications, torpedo-boats and coast-defense vessels with a flanking fleet of armored vessels, as advocated by some high naval authorities. Not to prey on the enemy's commerce and thus force a peace, for we have no coaling stations, and few fast cruisers in comparison with some of our possible enemies.

We have some cruisers and are building others. We are building some gunboats, and are to build three armored vessels, with one or two torpedo-boats. If there is any definite end towards which we are striving, if there is any definite number of vessels or class of vessels which is the limit towards which we are aiming, it has not been made public. The Army has a definite plan for defending our coasts, but where is ours? To be sure, if the Army plan be adopted as the correct one, there is but little need for a Navy. It has a few peace duties and may manage some torpedo-boats and three floating batteries. If these will protect our coasts, what more can the Navy expect? for it can be hardly contemplated to build an armored fleet that will enable us to make aggressive demonstrations against the great maritime powers of the world. But imagine—the necessity for a Navy having been recognized—a Navy has been built. War is declared; an admiral is placed in command of our fleet. Will he be allowed to form his own policy, or will one be dictated to him? Where will he get the necessary information as to the constituents of his force, and as to the supplies he may rely upon for carrying on the war? For-

tunately we have an Intelligence Office that will give him all information about the enemy. Will he take a staff, as at present, or will he be allowed to choose one more in accordance with modern requirements? Without a purely military branch in the Department, the first operation of war must be made at haphazard, or be dependent upon the will and brain of the commander chosen, who, in place of bending all his energies to the combat, must supply the details neglected in time of peace because of a faulty system of administration. It is to be hoped that Admiral Luce's paper will serve to crystallize naval thought, and that the energies of all who bear the interest of the Navy at heart may be bent towards accomplishing this much-needed reform, of the separation of the military from the civil business of the Naval Department.

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A PROPOSED SYSTEM OF MESSING THE CREWS OF OUR MEN-OF-WAR.

By Lieutenant Daniel Delehanty, U. S. Navy.

It will be unquestionably conceded that the messing of a man-of-war's crew in our service is the most imperfect part of its organization. Every line officer is familiar with the annoyances and discomforts that result from it, and how utterly out of harmony it is with the general organization of a well disciplined ship. Time, with its changes in types of ships, ordnance, etc., has forced upon us changes in the various other organizations; but in the matter of messing, so important to the health, contentment, and general welfare of the men, we remain to-day very much in the same condition as when our navy sprang into existence.

We all know the objections to the present system: the untrained, untidy cooks, and the impossibility of obtaining the requisite number of men suitable for the duty; the ruining in its preparation of the good, generous ration furnished by the Government; the old and unclean manner of washing mess gear; the necessarily wasteful system of apportioning out the mess stores to the numerous cooks; the frequent complaints of the messes against each other for purloining sea stores; the delay in clearing up the decks after meals and especially when boats' crews or other parties of men are absent; and the difficulty of keeping satisfactory meals for such absentees. It is reasonable to assume that any proved system which eliminates all these objections would challenge the consideration of every line officer and demand a fair trial. The following plan does eliminate them, and in addition spares the Executive and Paymaster many annoyances and a considerable amount of unnecessary labor, gives the greatest satisfaction to the men and adds materially to their comfort, at the same time doing away with the custom of contributing to a mess fund from their scant wages. This statement is based on a twelve months' trial of the system on board the Independence, with the number of men on board during that period ranging from two

hundred to over three hundred. I am confident that the same system, with slight modifications (which will be indicated), might be adopted on board cruisers with the same excellent results.

The Independence organization consists of one mess for the entire ship's company, appointed petty officers included. The mess is served by one ship's cook, one pantryman, and one messman for every twenty men. With a large number of men on board, an assistant cook and an assistant pantryman are necessary. All the rations are commuted and form a mess fund in the hands of the Paymaster. The pantryman alone receives extra compensation—twenty dollars per month being paid him out of the mess fund; this, with the pay of his rate, secures an efficient man for the duty, which is of the first importance.

A pantry was built forward on the gun-deck, abreast the galley, with sufficient locker room for groceries; a large sink for washing mess gear, with waste pipe leading overboard, the necessary shelving, and a strong table about five feet by three feet were put up. A bread-bin was built against and abaft the after athwartship pantry bulkhead, large enough for two days' supply of bread, one end of the bin being partitioned off for flour.

It was at first intended to keep all the mess gear in the pantry, but it was found that this would make the room inconveniently large, so one mess chest for each twenty men was used for crockery *only*, the cutlery being kept in the mess table drawers, so arranged that it could be thoroughly inspected at a glance.

Three reliable caterers were appointed, the master-at-arms, paymaster's yeoman, and a corporal of marines (the mail orderly); and they selected, with the approval of the commanding officer, a grocer, butcher, and baker to furnish the supplies. It was explained to these tradesmen that their bills would be paid by the paymaster of the ship at the end of each month, and as their sales would be large, they must furnish the best of everything ordered at the lowest market rates. It was manifestly their policy to do this, for, under the old system, the mess money, amounting generally to one hundred and fifty dollars per month for each mess, including commuted ration money, was entrusted to the mess cooks to pay the mess bills, and they not unfrequently deserted with the entire amount; and as the messes in such cases were invariably unwilling to make good the debt, and the tradesmen loth to insist on it through fear of losing the trade, the latter had to submit to the losses, and in order to protect themselves they charged higher prices to cover such contingencies.

The caterers purchase the supplies daily, and deliver the pass-books to the executive officer for his inspection. The latter keeps at hand a daily corrected record of the number of men attached to the ship, so that it is a simple calculation in examining the books to determine whether or not the daily ration amount has been exceeded. Every morning after the liberty list has been signed, the caterers are notified of the number of men who will be absent on the following day, and the orders for supplies decreased accordingly, thus saving to the men what under the old system would have been wasted. After a brief experience, the caterers, being intelligent men, acquired an exact judgment of the quantity of provisions to be ordered under all circumstances, so that each man had an abundance to eat, and nothing was wasted.

At the end of each month the tradesmen submit their bills, which, after being certified to by the caterers as correct, are approved by the executive officer, and finally by the commanding officer, who orders the paymaster to pay the same and charge to the general mess fund.

Under the old system each man was required to pay a mess assessment of three dollars per month; under the present plan none is required, but, instead, a surplus of over three hundred dollars had accumulated at the end of the first three months, with a decided improvement in the character and preparation of the food. The surplus is never allowed to exceed five hundred dollars. It accumulates in the summer, when provisions are cheap, and is drawn upon in the winter, when the prices for the same are higher, so that the fare throughout the year is uniformly good; it is also drawn upon when necessary to renew mess gear, and on holiday occasions when the men are given an especially good dinner.

The duty of the pantryman is to prepare all the food for the galley and tables; in other words, his duties are to this extent those of a steward. He and the ship's cook work together, and are assisted, when necessary, by regular details from the messmen.

The messmen are detailed from the rates below seaman, one private for the marine guard, the latter always messing together. As the duties of the messmen are simply mechanical, requiring no knowledge of the preparation of food, all the men in the rates of ordinary seamen, landsmen and coal-heavers, excepting those otherwise specially detailed, are required to perform the duty in rotation. The detail is changed monthly.

The men are not assigned to any particular tables or seats. The

one rule in this respect is, that they shall first fill up all the forward tables, leaving the vacancies in the after ones for any absentees. When any number of men are detained from meals on duty, such as boats' crews and working parties, the officer of the deck sends an order to the pantry, and on their return they are served with meals as hot and as good in all other respects as when the meal was "piped." No other tables excepting those occupied by these men are delayed in clearing off, and when the hands are turned to, except on very unusual occasions, the decks are ready for the sweepers. Such men as receive their meals at seven bells—sentries, quartermasters, and the watch of the engineer's force—are served together at the same table, which is again in readiness at the regular meal hour.

The system is most convenient when men are sent on detached duty, as they may be supplied with their ration money out of the mess fund, or the executive officer may direct the caterers to procure from the tradesmen stores suitable for the occasion. Under the old system, when large drafts were sent from the ship, it invariably happened that one or more of the messes were reduced below the number of commuted rations allowed in such messes; this resulted in much trouble to the executive and paymaster and in a reorganization of the messes. Another serious objection to the old system is very manifest when recruiting. As the recruits become at once largely indebted to the Government for their outfit, they can receive no money for several months, and have therefore none to pay into their messes unless they draw and sell extra clothing and small stores. To prevent this requires the closest scrutiny on the part of the divisional officers, which is not always given, and, in consequence, additional labor falls upon the executive. When the recruits fail to pay their assessments, either the other men in the messes are directly taxed for the deficiency, or the tradesmen nominally bear the loss, which, as before remarked, they recover through increased prices. Hence, recruits are an undesirable element in the messes, and it is always a source of daily trouble to keep them equally distributed and the messes equalized.

WHEN THE CREWS OF VESSELS UNDER REPAIRS ARE TRANSFERRED TO THE RECEIVING SHIP WITHOUT THEIR PAY ACCOUNTS.

As this frequently occurs, it was thought by many officers that it might not be practicable to conduct satisfactorily the two systems of messing in the same ship, in which event the system on trial would be a failure as far as receiving ships are concerned. This possibility

had been duly considered, but as a practical test was the only means of determining the result, one was awaited with interest, and when it occurred it proved to be in the highest degree satisfactory. There was no hitch whatever, from the first to the last meal. On the contrary, it was found to be an advantage to the transferred crew, in giving them a larger share of the galley than they would have had otherwise. This latter crew kept its organization intact. The meals were served for all hands at the same hours.

THE SYSTEM AS ADAPTED FOR CRUISERS.

It would be neither practicable nor desirable to commute all the rations as for a receiving ship. It is proposed to commute no more than are ordinarily commuted in sea-going ships; but as all the men are to be in one mess, all the rations to be commuted shall go into the general mess fund, and the stores procured with this fund shall be kept in one place and under the control of the pantryman.

If it should be found that this does not give to the crew abundant and satisfactory fare, which I confidently believe it will, a much smaller assessment would undoubtedly be required to produce this result than under the old system. The sea stores will not be scattered about, unprotected except by tags to indicate ownership, and the mess chests may be kept absolutely clear of food. All the regulations applying to receiving ships, with the exception of commuting *all* rations, can be applied to cruising vessels with the same excellent results.

To perfect the organization requires at first a constant supervision and careful attention to all the details by the executive officer. When this is given, the system will, like any other matter of routine, soon drop into a satisfactory and labor-saving groove.

The advantages of the system are briefly as follows:

1. It requires fewer mess attendants.

2. It substitutes one efficient pantryman for a numerous body of inefficient and slovenly cooks.

3. It facilitates clearing the tables and decks after meals.

4. When boats' crews or working parties are late for meals, the least possible disturbance to the routine ensues, and the men on their return to the ship are properly served.

5. For boat expeditions, or other duty requiring a prolonged absence from the ship, the most suitable mess stores for the occasion can be promptly supplied.

6. All mess stores are kept in one place, and under the control of one man.

7. No matter what transfers may take place in the crew, either in or out of the ship, the mess organization will not be affected by them.

DISCUSSION.

Commander FREDERICK RODGERS.—Referring to the excellent paper of Lieutenant Delehanty upon the proposed system of messing the crews of vessels of the United States Navy, it may be proper for me to state that I am especially competent to pronounce it a success so far as receiving or stationary vessels are concerned, from the fact that I was in command of the Independence when the system under discussion was inaugurated in that vessel, and for a sufficient time afterward to enable me to observe the working of it and its general effect in reference to the discipline of the ship and the comfort of the men.

Lieutenant Delehanty has given a plain statement of the manner in which the change in the method of messing was introduced and carried on. During the time I had command of the Independence, several orders relating to the commutation of rations on board ship were issued, the effects of which were to leave the commanding officer very little discretion in the matter and afford little benefit to the crew. Finally, when a general order or circular was issued giving the commanding officers authority to commute rations as they might deem advisable, the idea of commuting them all suggested itself, and the results were :

1. A great saving of food, or at least of the value of food, formerly wasted.

2. Increased comfort and better food for the men.

3. A decrease in the number of men required to attend the various messes and known as berth-deck cooks.

4. In consequence of the more systematic arrangement of messing, a gain of time in preparing meals and clearing up the decks.

5. A great comfort to the men and convenience to the executive and other officers when sending off detached parties. Men going off can be furnished with prepared food and with whatever may be best adapted to the occasion, from the general mess, whereas it has generally been customary to simply order that men take their rations with them. I have seen this done when, with no opportunity for cooking, the rations were almost useless.

6. The practicability of placing recruits or men with no money on the same footing in the mess as the rest of the crew.

7. That once started and fairly organized, the proposed system admits of expanding or contracting the mess arrangements to any reasonable extent, without confusion or inconvenience.

8. A considerable saving to the Government.

It is well known that quantities of beef, pork, and other provisions which accumulate in store become spoiled from age, and a consequent loss is incurred.

By the introduction of this system of messing, in stationary vessels, a considerable reduction in the amount of perishable stores bought annually for the Navy could be made. Further, the expense to the Government of transporting provisions over long distances is considerable, and if such provisions as are needed can be bought upon the spot for the amount of the ration allowance, the result is a considerable saving in the matter of freight payments.

It is admitted that the Independence is well adapted to this manner of messing, but not better, perhaps, than other receiving or stationary training ships. It requires considerable attention upon the part of the commanding and executive officers to inaugurate the change and to see that the details are properly carried out.

What I have stated refers only to receiving or stationary vessels, as it remains to be seen whether any such arrangements can be successfully carried out on board sea-going vessels.

The principal difficulty, I presume, in the matter would be want of space. It is quite clear, however, that improvement can be made in the present system, particularly in the galley arrangements and the character of the berth-deck cooks, who, as a rule, are allowed to handle the ration money of the messes—a fact that not infrequently leads to theft and desertion and to discomfort to the mess. A modification of the mess arrangement under discussion might be made to work on board cruising vessels, and there are certainly some of its features which could be introduced, particularly as regards cooks and messmen.

I will say, in conclusion, that my successor in command of the Independence, Commander John W. Philip, an officer of extended experience and excellent judgment, is emphatic in pronouncing the proposed system a success, and as he has had ample opportunity to observe its working, his estimate of it has great weight in confirming my own impressions.

Lieutenant Edward F. Qualtrough.—The advantages of the proposed system of messing ship's companies have been so clearly set forth by Lieutenant Delehanty, in the paper under discussion, that I shall confine my remarks to bearing testimony regarding the admirable manner in which the system worked on board the receiving ship Independence. I believe that all the officers who inspected its practical operation on board of that vessel were very favorably impressed by it, and the Board of Inspection made quite a lengthy report regarding it. While it has up to the present time, so far as I am aware, been tried only in receiving ships, there appears to be no good reason why it should not answer, with some slight modification, for regular cruising vessels. The proposed plan seems to me to breathe the true spirit of progress, and, if given a fair trial in actual service, it appears probable that all of the imaginary difficulties in the way of its general adoption may disappear.

Lieutenant Chas. Belknap.—I have read Lieutenant Delehanty's paper with a great deal of interest, and I think it will not be questioned that the plan of messing crews that he details is a great improvement over the present system, so far as receiving ships are concerned. The gain in cleanliness and comfort

is apparent, and it may be noted that the proposed system is admirably adapted to the case of the men living in barracks, which all must hope will soon be substituted for the present antiquated and unsatisfactory receiving ships.

But when we come to ships in commission, the question at once arises, will the proposed system prove satisfactory? The conditions are so entirely different, the expenses of sea stores incidental to the numerous changes of position of a cruising ship are so much greater than for the daily food when in a fixed port, the desires of the sailors for food—from the old shellback who wants salt horse and hard tack daily, to his younger brother who wants fresh meat and soft tack—are so varied, that I must confess I prefer to have some one else make the experiment.

Perhaps there is some one present who may be able to give us his experience in regard to the matter, which is one of interest to all of us.

Lieutenant C. G. CALKINS.—Lieutenant Delehanty has one great advantage over most of those who undertake the discussion of questions of naval organization and supply: he has been able to test his plan of reform by actual experiment. This gives his paper special value as a record of successful innovation. For the success of the experiment on board the Independence is as unquestionable as the importance of messing arrangements as factors of discipline and efficiency in the service.

The practical suggestions of this paper are no less valuable than its record of accomplished facts. The conclusion in favor of a general mess for harbor ships of all classes is supported not only by the experiment carried out at Mare Island, but also by the figures in regard to the contracts for feeding the marines in barracks at the various shore stations. The advantages of the proposed system for seamen in home ports can hardly be questioned. Its extension to cruisers will require consideration.

It must be admitted that a good system for messing the crews of sea-going men-of-war is of vital importance to their efficiency, and that our present methods are very imperfect. While men must sprawl about grimy mess-cloths spread on damp decks, no ration, however generous in quantity, can make their meals comfortable or satisfactory. Now that we are to have ships built to satisfy modern requirements, we may hope to spread neat tables on well-lighted and ventilated decks. If the messing arrangements can be further improved to enable men to take advantage of local markets for fresh provisions, and to have them well cooked and well served, the service will be vastly benefited.

Satisfactory meals are matters of prime importance in *morale* as well as in hygiene. Upon them depends much of the seaman's attachment to his ship. To check desertion and to Americanize the Navy, we must assimilate our messes to the tables familiar to men of the classes which we desire to attract and to retain in the service. The single or general mess system will probably be adopted by school-ships and receiving ships, and recruits and apprentices will not easily reconcile themselves to the scrambling mess arrangements of sea-going ships, with assessments to keep them running.

There would seem to be reason for making the practicability of this system in cruising ships a matter of experiment. The practical difficulties may then be studied and perhaps eliminated. If one ship on each cruising station were directed to test the system thoroughly, and to report results in detail, a comparative study of their accounts, with those of vessels similarly employed under the old system, should lead to definite conclusions. A board of three officers disposed to give the proposition a fair trial should arrive at some practical result in a few months' time.

The proportion of rations to be commuted would require full consideration, as well as the allowances to be made to the general mess for articles not drawn for consumption. At present, seamen pay $2 or $3 monthly for their messes, and have hard bread and other provisions of considerable value undrawn without receiving any credit therefor. Some allowance should be made for stores which do not deteriorate and are not lost on account of the disinclination of the crew to consume them.

An objection may be based upon the assumed difficulty of fitting out parties of men for detached service from stores belonging to a general mess. But the present methods are so unsatisfactory that the problem of supplying expeditions needs to be worked out in detail on a new basis. It would seem that the necessary modifications would fit the proposed messing system quite as well as the one now in use.

It may be best to establish an "ironclad ration" of cooked and concentrated food to be carried by each man sent on distant service. Or the problem may be solved by providing suitable water-proof packages of metal or tarpaulin for the component parts of the Navy ration, to be filled when occasion requires. The packages in which such goods are purchased and issued are usually unfit for handling in boats or on the march.

The supply of mess-gear for boats and landing parties should also be separated from the ordinary table furniture of the messes. Tin pots and pans made to nest in stowing and to be slung to the equipment for marching should be kept in readiness. The men should not be expected to forage from their messes for mess gear.

Improved and simplified cooking arrangements for boats and camps are also needed. With a proper marching ration, hot water is the only requisite for rough cooking. This should be supplied from a modified Russian samovar, heated by cakes of compressed charcoal burned in a central flue.

The foregoing suggestions may serve to show the nature of the problems upon the solution of which the equipment of boats depends. It is intended to show that no argument against a general mess can be based upon the equipment of detachments for distant service.

Of course the proposed system must stand on its own merits, which have been clearly stated by Lieutenant Delehanty in his concluding paragraphs.

Commander Joshua Bishop.—The mess arrangements on board of naval vessels is a subject of the greatest importance. The discussion of this topic cannot do otherwise than conduce to more economical and better facilities

than exist at the present time. The paper submitted to the Naval Institute by Lieutenant Delehanty, U. S. Navy, is a timely and valuable one. The effort made to solve this question on board the U. S. R. S. Independence should be commended.

Every officer and person in the naval service on board ship has his place and duties assigned him, and is furnished with one ration. The rations of officers and of a limited number of the crew may be commuted into money at thirty cents a day. Stewards, cooks and servants are provided for the service of officers at the expense of the Government. Yeomen and their assistants, cooks, and a detail of one man from each mess, are provided to issue, receive, provide and serve the rations to the crew.

The great difficulty met with in feeding the crew is, in not having a proper person to direct in the converting of this ration into palatable dishes, in the methods and in the times of service of the food to the crews of vessels.

In the service of the officers' messes there is a very expensive and inharmonious method of feeding a few people. Economy in servants, in expense to individuals, and more efficiency are desirable.

Our merchant marine have one officer, the Purser, whose duty is to care for the commissariat of the vessel.

The captain, other officers, and the crew are provided with food in designated places, at the expense of the vessel.

This duty of superintendence of issue, of cooking, and of service of the ration can be assigned to the Pay Corps of the Navy, and by the same methods as are practiced on board of large passenger steamers.

There are many reasons why it would be advisable for the Government to subsist the officers as well as the crews of vessels.

There need be no change in the place of messing of the captain, officers, or crew of the vessel.

Do away with the present system of ration, with the methods of commutation and stopped ration, and with private mess funds, fees to cooks, and in its place provide that the officers and crew of vessels be subsisted by the Government under the direction of the Pay Officer of the vessel. The provisions, stores, mess and cooking fixtures, and table arrangements, to be in charge of, and that all servants be under the direction of, the Pay Officer of the vessel, for mess purposes.

Provide by regulation for suitable bills of fare for different messes, the times of messing, and duration of the meal hour—the old "meal hour" to be done away with. The crew shall not be sent to meals at one time.

The messing hour for each crew-mess to be designated, and at this time the mess to be formed in line under the direction of an officer and marched to table, ample time being given for the meal. During the time they are under this formation they shall not be called on for service on deck. The smoking lamp to be lighted, except during drill hours, when all hands are called, or after 9 P. M.

The crew of vessels to be arranged in classes for messing, the servants to form a class, and to be provided with meals, so that they may be ready to serve the others.

Provision can be made by naval regulation for the entertainment of guests, official or private, by the captain or other officers.

The day should be divided into periods—hours for meals, hours for cleaning up, or preparation of meals, and of hours for drills, so that during drill hours the whole force may be available.

Early coffee, 4.30 to 5 A. M. Breakfast, 7 to 8.30 A. M. Morning drill hour, 9.30 to 11 A. M. Dinner, 12.30 to 2 P. M. Afternoon drill hour, 3 to 4.30 P. M.; and supper, 6 to 7.30 P. M.

The working hours for the crew are at all times except the designated messing hours or when at quarters.

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U. S. NAVAL INSTITUTE, NEWPORT BRANCH,

OCTOBER, 1888.

NOTES ON THE LITERATURE OF EXPLOSIVES.*

BY CHARLES E. MUNROE.

No. XVIII.

In November last, at Sandy Hook, in the presence of the Army Ordnance Board, three rounds were fired with shell charged with insensitive nitro-glycerine, according to the method of S. D. Smolianinoff, described in these Notes.† The firing was from a 100-pounder Parrott. The weight of empty shell in the first two rounds was 89 pounds, and the weight of explosive was 4.6 pounds; in the last round the shell weighed 82 pounds, explosive 4.1 pounds. Except that the turret section had no roof, the target was in all respects similar to that used in the Graydon ‡ experiments, even in the respect that it had been fired at before and showed the indentations of former shots. It was mounted in the same manner, and the range also was the same, 101 yards. The powder charge decided on was eighteen pounds Dupont powder. Previous trials had shown that this charge with an 87-pound projectile gave a velocity of 1494 foot-seconds and a pressure of 26,700 pounds per square inch.

First round.—Shell (not fuzed) struck the target in the left-hand lower corner, twelve inches below the horizontal joint and within the edge of an old indentation, and broke into minute fragments. A low

*As it is proposed to continue these Notes from time to time, authors, publishers, and manufacturers will do the writer a favor by sending him copies of their papers, publications, or trade circulars. *Address Torpedo Station, Newport, R. I.*

†Proc. Nav. Inst. 13, 173; 1887.

‡ Proc. Nav. Inst. 14, 156; 1888.

order of explosion resulted, as evidenced by the black smoke and the character of the sound. The front plate was cracked to the joint, otherwise the damage was all on the surface. Several bolts that had been broken in previous firings were jarred out by the shock.

Second round.—Shell fitted with percussion detonating fuze. Struck slightly above and six inches to the left of the first shot, and broke up. Explosion, although not of the first, was much higher, order than in the previous round. A $2\frac{3}{8}$-inch bolt was broken in two, and some slight surface damage was done. The wooden foundation of the turret was badly broken up.

Third round.—Shell (fuzed) struck a few inches above No. 2 shot and broke up. Explosion of lower order than in No. 2 round, and higher than in No. 1. No material damage done to the target.

The weakness of the cast-iron shell used in these rounds, and also the shape of the head, which was adapted to a nose-fuze, precluded any possibility of penetration, without which no really useful result could be looked for. The firing was successful in the respect that no damage was done to the gun.—*Gen. Information Series* (U. S. Navy), **7**, 378; 1888.

Mr. Hiram Maxim, the inventor of the automatic machine and R. F. guns, has recently secured letters patent on designs for a dynamite gun, for which several advantages are claimed over the Mefford* gun.

In the preamble to his specifications Mr. Maxim says: "It has heretofore been customary to utilize compressed air in dynamite guns for discharging the projectile therefrom; and in order to obtain a higher muzzle velocity of the projectile it has been necessary to make such guns with very long barrels, and to employ air under very high pressure. By my invention I am enabled to reduce greatly the length of the barrel and the pressure of air employed, and, at the same time, to obtain a very high muzzle velocity."

Instead, therefore, of charging the gun with compressed air alone, Mr. Maxim uses a mixture of air and some volatile hydrocarbon (gasoline, for example), in such proportions that there will be just sufficient oxygen in the air to convert the hydrogen of the hydrocarbon into water, and the carbon into carbon dioxide. This mixture may be used at a pressure equal to about one half of that ordinarily

* Proc. Nav. Inst. **13**, 567; 1887.

employed in pneumatic dynamite guns. After the projectile has been driven by the expansive force of the compressed gas that enters at the initial pressure, through from one quarter to one half the length of the bore, the mixture is caused to explode, and the pressure is at once increased about eightfold.

The apparatus for causing this explosion consists of a detonating cartridge, so placed in an axial chamber in the wall of the gun as to have a longitudinal play of about a quarter of an inch; the chamber being some distance in advance of the projectile when seated, and the outer end of the chamber being fitted with a steel firing pin. The compressed air and hydrocarbon having been introduced into the bore, the projectile moves forward until it uncovers the interior opening of the axial wall chamber, when the gas, impinging upon the detonating cartridge, drives the primer against the firing pin and ignites the mixture in the bore.

Two projectiles have been designed, one for rifle, the other for smoothbore guns. In the latter case the rotary motion is imparted by means of vanes or screw-blades, as with the projectile for the Mefford gun; while the bursting charge of the shell is detonated by means of a capsule and firing pin in the hollow tube to which the blades are attached. It is not understood that any gun of this description has yet been built.—(*Loc. cit.* 352.)

The Rival Air-Gun Company have issued a large quarto pamphlet* with seven plates, entitled "The New Pneumatic Gun or Aerial Torpedo Thrower," describing a device for firing shell charged with high explosives, based upon the inventions of J. W. Graydon. This gun is in principle similar to Mefford's gun, but where the latter is from seventy to fifty-five feet in length, the former is from one half to one third as long. The reduction in length is accomplished by using a greatly increased air pressure, and the company claim to be able to do this with safety, owing to the manner in which the high explosives are packed in the projectile. Owing to this shortening of their length, these guns may be elevated, depressed and trained like any piece of ordnance, a performance which is impossible with the Mefford gun. The guns of this pattern are from three to twenty-one inches in caliber, throwing from six pounds to 1200 pounds of high explosives, under air pressures running up to 3000 pounds per square inch. The range varies with the pressure up to three miles. Besides the short-

* Washington, 1888.

ening of the gun, the great increase in pressure enables them to get a flatter trajectory and greater range than the Mefford gun yields. Other new devices offered in connection with the gun are an air valve, a new condensed fuel for use with the air compressor, and a new fuze. The firing connection for this fuze is operated by the pressure of water, and is regulated for any depth. When that depth is reached, the firing plunger is unlocked and the torpedo is exploded, while, until that condition is fulfilled, explosion from any cause is claimed to be impossible.

It is obvious from these abstracts that this invention is offered in competition with the pneumatic dynamite gun.

Graydonite is a name given to an explosive by J. W. Graydon, for which he claims absolute freedom from danger in handling or transportation, simplicity of manipulation, and a destructive power 400 *to* 700 *per cent higher than dynamite No.* 1. A circular advertisement contains very favorable reports of a trial of the explosive made at Table Rock quarry on the Potomac, in May, 1887.—(*Loc. cit.* 374.)

Through the courtesy of General H. L. Abbot we have received a copy of the *Forum** for September, 1888, containing a very thoughtful and interesting article by him, on "The Use of High Explosives in War," in which he reviews the progress which has been made in the applications of high explosives to the art of war, and shows that they have proved a most important gain for the engineer in the destruction of material, removal of obstructions in mining and in countermining; that the success thus far attained in firing shell charged with high explosives from gunpowder guns has demonstrated the weakness of our hitherto impregnable fortifications; and that the gain, as between ships and forts, is rather to the advantage of the latter, and is in favor of the rich and powerful nations rather than the poor and weak.

In concluding he remarks: "No reference need be made to the proposed mode of projecting charges of high explosives from pneumatic guns, because no official trials have yet been made with the pattern proposed by the inventors for service; because the ranges claimed are too short to meet the requirements of the problem; and because throwing the new agents from ordinary guns will do away

* 6, 65–73; 1888.

with the supposed need of the invention. That larger charges may perhaps be thrown from a pneumatic tube than from a gun is not very important, because the destructive effect of the explosion increases only with the square root of the weight, *i. e.*, a 400-pound charge is only twice as destructive as a 100-pound charge, and in most cases four 100-pound charges are more to be dreaded than one 400-pound charge."

The *Army and Navy Jour.* **25**, 826, May 5, 1888, states that during the progress of some artillery experiments at Fort Tiburina, just outside of Rome, on May 1, a dynamite shell exploded and the Crown Prince of Italy was slightly wounded in both sides. The general commanding the home division of the army was also slightly wounded, two colonels received serious injuries, and two captains dangerous ones.

*Mélinite** is generally believed to be a mixture of fused picric acid, in granules, with trinitrocellulose dissolved in ether. M. Turpin, its inventor, is now free to offer his secret to any government that may choose to purchase it, but the French claim that their *mélinite* of to-day is so different from the original substance that not even the inventor would recognize it, and that they have reached such a state of proficiency in its use as to put them at least three years in advance of any possible rivalry. It is reported that the secret has been purchased by Sir William Armstrong. It is known that experiments with one form of *mélinite* are now progressing in England, but so far the particulars have been carefully guarded.

Precautions are taken to guard not only the secret of the manufacturing processes, but also the performances of the explosive. Notwithstanding this, it has transpired that in the Belliqueuse experiments, the effect of the shell striking against the armored portion of the ship was practically *nil*, the points of impact being marked by only slight surface indentations. On the other hand, the shell that struck the unprotected parts are said to have created "terrible havoc." This expression, which is copied from various editorials of the French press, is a rather vague one, but, at all events, the havoc was such as to cause many French naval experts to advocate a reversion to complete armor; and it is said that the designs of several ships now building (the Brennus and Dupuy de Lôrne are mentioned by name)

* Proc. Nav. Inst. **14**, 151; 1888.

have since been modified especially to meet the fire of high explosive projectiles.

It is stated that the French have succeeded in firing *mélinite* shell from high-power guns with velocities as high as 2000 foot-seconds. The weight of the *mélinite* charge in this case is not mentioned, but it is known that charges of nearly 70 pounds have been repeatedly fired from the 22-centimeter mortar, with velocities of over 1300 foot-seconds.

Max Dumas-Guilin, in the manual noticed elsewhere, states the explosive force of *mélinite* to be only three times that of gunpowder; other statements represent it as from five to eleven times as powerful, but M. Guilin evidently has the weight of authority on his side, and is entitled to the greater credence.—(*Loc. cit.* 373.)

The current press reports that an explosion has occurred in a *mélinite* factory at St. Omer, France, and that before the flames were subdued, six factories and two houses were destroyed.

The Emmens Chemical and Explosives Company, of Harrison, N. Y., have issued a "Report on Emmensite," by Baron Louis H. de L'Espee, in which it is stated that emmensite* is prepared by fusing together five parts by weight of emmens acid and five parts of a nitrate (preferably sodium or ammonium nitrate) in a paraffin bath, and then incorporating six parts of picric acid. Emmens acid is obtained by dissolving commercial picric acid, at a gentle heat, in fuming nitric acid (50° to 52° Baumé), and evaporating, when the new acid is deposited in rhomboidal prisms of a fine yellow color. According to Dr. H. Wurtz, of New York, this acid has the formula of $H_2C.C_{12}H_6(NO_2)_6O_2.H_2O$, and may be regarded as being intermediate between tri-nitro-phenol and tri-nitro-cresol. Emmens acid differs from picric acid in its crystalline form; in being less soluble in water and alcohol; in giving ruddy vapors when heated, and in possessing a *golden* yellow color. It is claimed that by the process of manufacture of emmensite above described, the whole mass is converted into a compound of emmens acid.

Elaborate calculations are employed to determine the explosive value of emmensite as compared with nitroglycerine and other high explosives, and taking dynamite No. 1 as equivalent to 100, guncotton is found to be 120.54, explosive gelatine 154.29, nitroglycerine 183.72, emmensite 236.60, and fulminate of mercury 1229.76. These

* Proc. Nav. Inst. 14, 435; 1888.

theoretical conclusions are said to be confirmed by numerous experiments, some of which are described in this pamphlet.

It is proposed to use this explosive not only in mining, but in a granulated form as a substitute for gunpowder as a propelling agent in guns, for which purpose it is claimed to possess three times the power of gunpowder, while it produces no smoke, does not foul the piece, and is safe against violent blows or shocks.

Its sensitiveness to shocks has been tested by Lieutenant Zalinski with the following apparatus: He fits a stout tube, closed at one end, into an air-chamber, so that the mouth of the tube opens into the chamber, and he places the explosive in the tube and closes the mouth of the tube with a steel plate. Then he introduces compressed air into the chamber until it attains a pressure of 4000 pounds per square inch, or more than 300 atmospheres, when the plate breaks and the explosive is exposed to the impact of this highly compressed air. Under these conditions, nitroglycerine, gun-cotton, dynamite, and gunpowder exploded, but emmensite failed to explode.

The *Pittsburgh, Pa., Dispatch* states that a gun is now being constructed in that city for the American Emmensite Company, with which to demonstrate the value of their explosive. It is to be a smoothbore, 3 inches in diameter and 100 inches long, and is expected to throw a 6-inch (*sic*) shell filled with emmensite from 10 to 12 miles. It is explained that in rifled cannon the shell turns 1¼ times in the length of the gun; that this causes a terrific torsional strain, which necessitates a great increase in the thickness of the shell, with a proportionate reduction in the space for the explosive; and that the Emmensite Company return to smoothbores to avoid this trouble, while they rely upon the great power of their explosive to secure the necessary range.—*Ill. Nav. Mil. Mag.* **9**, 169; 1888.

Major J. P. Cundill, R. A., H. M. Inspector of Explosives, has reprinted in a separate volume his admirable "Dictionary of Explosives," which has appeared in installments in the Proc. Royal Artillery Inst. for 1887 and 1888. In this work, the explosives treated of are grouped in eight classes, arranged in alphabetical order in each class, and the whole carefully indexed. With each substance is given a brief but lucid statement of its composition, and, when of special importance, of its special properties and method of manufacture, while a succinct historical account and a notice of the general

characteristics precedes each group. The work is an invaluable one to those engaged in the study or use of explosives, its accuracy and reliability being insured from the experience and professional position of its author. From this work we learn that *Roburite** consists of a mixture of ammonium nitrate and meta-di-nitro-chlor-benzene; that *Romite*† consists of a mixture of ammonium nitrate, naphthalene or nitro-naphthalene, and potassium chlorate; and *Securite* consists as a rule of 74 per cent of ammonium nitrate with 26 per cent of meta-di-nitro-benzene, though other varieties have been made which contain the tri-nitro-benzene and the di- or tri-nitro-naphthalenes.

A new variety of "securite" has been prepared by Herr Schoeneweg, which is said to be flameless when exploded, and will, it is expected, be of especial value as a substitute for ordinary blasting powder and other explosives in fiery coal mines. It consists of nitrated hydrocarbons mixed with an oxidizing agent, such as chlorate of potash, and some organic salt which renders the mixture flameless. The substance is not hygroscopic, and is of a bright yellow color, and can be kept for any length of time without undergoing any change. It cannot be exploded by a flame nor by a hot substance, but only by a detonating cap. Recent experiments at Hendon have proved that the new explosive fulfills the anticipations of the inventor, and we understand that the Flameless Explosives Company have undertaken to introduce it to the notice of mine owners and others to whom an explosive of this nature should be welcome. Its power is said to be equal to that of No. 1 dynamite, and it can be manufactured at a less cost. The organic salt which is added to the "securite" to produce this effect has also the property of rendering dynamite similarly flameless when mixed with it.—*Sci. Am.* **58**, 263; 1888.

The numerous explosions at various parts of Stockholm (there were thirteen) which occurred during one or two exceedingly hot days in the last week of June, seem all to have been caused by the spontaneous decomposition of explosives. It appears that *romite* was kept at eleven of the thirteen places, and that it has probably also been found at the remaining two, and further, that the explosions in two instances (at Marieberg and Skinnarviken) must have arisen

* Proc. Nav. Inst. 13, 575; 1887. † Loc. cit. 574.

through the spontaneous ignition of this same explosive. Further researches into the matter are pending.—*Engineering*, **66**, 35; July 13, 1888.

Both in Germany and in France, extensive experiments have been carried out with the object of producing an improved powder which shall be comparatively smokeless* and non-corrosive, and at the same time give higher initial velocity without corresponding increase of pressure.

In Germany, gun-cotton and nitro-lignin have chiefly been experimented with, while in France, much attention has been bestowed upon picric powders.

The French Brugère powder, which is composed of ammonium picrate and potassium nitrate, is said to give high velocities (over 2000 foot-seconds with small arms), and to cause only very slight recoil. Large numbers of cartridges of this powder were ordered for the new Lebel rifles, but it is stated that a recent examination of a quantity of this ammunition that had been stored at Chalons showed that the powder had deteriorated to such an extent that the whole lot had to be condemned.

France is now experimenting with gun-cotton powders, and has already obtained some marvellous results; some reports say velocities as high as 2500 foot-seconds have been reached. The powder is practically smokeless.

The powder with which 2380 foot-seconds was obtained from the Armstrong 36-pounder rapid-firing gun is a German invention. Although not smokeless, the smoke is much less in volume than that from ordinary powder, and is speedily dissipated. The same German experts have perfected a powder for small arms which is said to be absolutely smokeless. This has been adopted as the service powder of the German army. The right to this invention has been secured by the Chilworth Gunpowder Company, in England, and the company announces itself as already prepared to turn out both rapid-fire gun and small-arm powders in quantities as large as are likely to be required by the Government service.

Under the name of Paleina, the *Rivista di Artiglieria e Genio* describes a straw powder invented by a French officer which is stated to be suitable to both military and mining operations, to be smokeless, and to possess remarkable explosive force.

* Vide Proc. Nav. Inst. 13, 593; 1887.

The mode of manufacture is as follows: The straw is first subjected to a process which makes the fibre soft and pliant, and is then washed and triturated in an apparatus similar to that employed in reducing rags to pulp. From these operations the fibre issues in the form of thin sheets, which are cut up and steeped first in a mixture of nitric and sulphuric acids, and then after careful washing to remove the excess of acid, in a solution of saltpetre and dextrine containing pulverized hardwood charcoal; the final product is dried in a current of air.

Paleina, as thus prepared, has the appearance of small disks of cardboard. In the open air it burns slowly and with a blue flame, but when detonated in a confined space it explodes with a force of about three times that of gunpowder. It makes no smoke and leaves no residue.

The straw has the property of absorbing nitroglycerine in a considerable proportion, and then forms an explosive superior to dynamite in power, and relatively safe and easy to handle.—(*Loc. cit.* 375.)

The *Revue Maritime et Coloniale*, 533, September, 1888, states that a new powder which is smokeless, while it possesses all the qualities of the best gunpowder, has been experimented with, and that it is prepared by using carbon from cork in the place of charcoal. By this means the hygroscopicity of the powder is very much reduced.

The exact nature and formula of fulminic acid and its compounds, owing to their extreme unstableness, is, comparatively speaking, little known. The following "Recent Investigations on the Fulminates," by H. N. Warren, offer further contributions to our knowledge of them.

The salt used to conduct the experiments with was silver fulminate. This being dissolved in hot water, and digested with copper filings, was transformed into cupric fulminate; the green salt obtained was dissolved in water and introduced into a tube open at either end, one extremity being closed by means of a porous diaphragm. The salt was reduced by means of nascent hydrogen, according to the usual method, by connecting the same with a small Daniell's cell, the inside of the tube being provided with a platinum electrode connected with the negative end of the battery. In the course of a few hours the whole of the copper had become reduced to the metallic form, and firmly attached to the platinum plate.

The solution obtained being thus freed from copper was next

examined and was found to contain, besides large quantities of hydrogen cyanide and ammonia, distinct quantities of fulminic acid, evidently existing as ammonium fulminate. This was obtained and examined as fulminating silver by digesting with silver carbonate. In every instance an explosive fulminate was re-formed, corresponding to the normal fulminate.

In the next experiment, cupro-ammonium fulminate was obtained by the addition of an excess of ammonia to a solution of cupric fulminate. The deep-blue crystals thus formed were, after being dried by suspending them over sulphuric acid, decomposed by dry hydrogen sulphide. The product consisted, however, chiefly of copper sulphide, with urea and ammonium sulpho-cyanide.

Further, an attempt was made to combine fulminic acid with silicon, by passing a stream of dry silicon fluoride over silver fulminate, kept moist by means of petroleum. Large quantities of silver fluoride were at once formed, and the escaping gas, when collected and ignited, exploded with considerable violence. Although the results obtained from several experiments performed by the same method agree with each other identically, it still remains an open question whether such a compound as silicon fulminate does in reality exist.

Chlorine, iodine, and bromine were also used, but chiefly gave rise to chloropicrin and other bodies of an allied formula. Experiments were also performed with the view of obtaining an ethyl compound, but these require further investigation before speaking definitely of them.—*Chem. News* **57**, 255; 1888.

Major Philip Hess states in the *Mitt. Art. Genie-Wesens*, *Notizen*, **47**, 1887, that in extracting the fulminating composition for detonators for analysis, he has been accustomed to loosen the composition by carefully squeezing the caps between boards until the case was somewhat flattened, rounding it out again, and again flattening it. Then by means of a camel's hair brush the contents are completely brushed out on to glazed paper. He finds that detonators will bear a good deal of gradual compression without exploding, and that a cork squeezer may be used for the purpose described above, but it is best to employ a safety-brake with it.

A. von Œttingen and A. von Gernet have repeated the work of Bunsen, Berthelot and Vieille, and also that of Mallard and Le

Chatelier upon the "Phenomena attending Explosions in Gases," making use of instantaneous photography to record the phenomena, and their results are given in a very valuable paper in the *Ann. der Physik u. Chem.* 33, 586-609; 1888. A rotating mirror was employed with a metallic pointer, to which an electric spark passed when the mirror was in the right position to reflect an image of the eudiometer tube, in which the explosion took place, into a photographic camera. The same spark served to explode the gases. The most sensitive Beernaert plate gave no trace of an image. No results could be obtained by staining the plates with cyanine or with azaline. Eastman's negative film paper, however, gave a faint image. The authors were compelled to sprinkle certain powders in the eudiometer tube. Chloride of copper gave the best results. Plates of the phases of the explosions accompany the paper. The experiments show that the explosion of hydrogen is not accompanied by light. The resulting high temperature, however, causes a disintegration of the glass of the eudiometer tube which produces a certain illumination. Three species of wave motion were observed: first, a fundamental wave, which is entitled Berthelot's wave; second, more or less parallel secondary waves; third, polygonal waves of smaller amplitude. The photographic image of the electric spark which was received upon the same plate as that of the explosion, enabled the authors to estimate the velocity of the explosion. The result obtained, 2800 meters per second, is of the same order of magnitude as that obtained by Berthelot. The authors agree in the main with Berthelot's conclusions, differing only in reference to the beginning and the end of the explosion. They explain the secondary waves on Bunsen's hypothesis of the reflex action of waves due to successive explosions produced by the electrical spark. They therefore term these Bunsen's waves.

Many experiments have proved that the velocity of sound obtained by observing from a known distance the instant of the discharge of a rifle and the arrival of the sound of the explosion at the place of observation, is frequently greatly in excess of the normal rate of propagation of sound. To determine the cause of this increase and the laws which govern it, a series of experiments have recently been carried out by M. Journée, who has presented a memoir on the subject to the French Academy of Science. His experiments show that if a bullet is fired from a rifle against an iron plate, then so long

as the velocity of the bullet is in excess of the normal velocity of sound through air, the noise of the explosion and of the bullet striking the plate reach an observer, situated in the plane of fire behind the plate, at the same instant. If the distance of the plate from the rifle is increased till the velocity of the bullet before reaching it is reduced below that of sound, then the noise of the explosion reaches an observer before that of the shock against the plate. Hence the author concludes that the bullet, so long as its velocity is greater than the normal velocity of sound, is the seat of a sonorous disturbance resembling in character that due to an explosion, and this view he has substantiated by further experiments.—*Comptes Rendus*, **106**, 244-247, Jan. 23, 1888.

The valuable paper by Sir Frederick Abel, on "Accidents in Mines," hereinbefore referred to,* is an outgrowth of his studies and researches as a member of the Royal Commission appointed in 1879 to deal with this subject, and as these accidents are due to a great variety of causes, and since each of these is treated of as exhaustively as the space permits, there is much useful and valuable matter which is not germane here, while the general results arrived at in regard to matters such as explosions due to coal-dust-laden air, and to those caused by explosive gaseous mixtures moving with high velocities becoming inflamed by safety lamps, have already been referred to in these Notes.† Hence we shall notice only that part of the paper which deals with the use of explosives in mines.

Formidable danger frequently attends the employment of blasting powder in coal mines on account of the flame which generally attends, though to a very variable extent, the firing of a shot tamped in the usual manner, and especially on account of the larger volume of flame which is projected to a considerable distance, either when a blast-hole is overcharged, or when the preponderating strength of the material operated upon gives rise to what is termed a "blown-out shot," the tamping being projected from the hole like a shot from a gun. These sources of danger were recognized long before any views were advanced regarding the possible connection of coal dust with mine explosions, and the precautions enacted for ascertaining the absence of any important contamination of the air at the working place with fire-damp before shots were fired, and for reducing to a

* Proc. Nav. Inst. **14**, 440; 1888.

† **8**, 308; **12**, 427; **14**, 439.

minimum the number of lives subject to possible danger when shot-firing was carried out, are well known.

Proposals have, from time to time, been considered by the inspectors of mines and others, for either abolishing the use of powder in fiery mines, or for greatly restricting its application by the imposition of more or less stringent conditions. When the Royal Commissioners gave this subject their attention and collected evidence bearing upon the dangers of shot-firing in mines and the possibility of dispensing with the practice, they were led to the conclusion that the abolition, or even the very considerable restriction of shot-firing as practiced under the existing laws, would be incompatible with the working of a large number of pits, except at a prohibitive pecuniary outlay. Realizing most fully, on the other hand, the dangers that frequently attend the use of powder in coal mines and the extreme difficulty of effecting any important diminution of those dangers, they devoted much attention to the question whether it might be possible to discover any powder substitute, or any method of using such substitute, which would secure immunity from danger due to the presence of coal dust and fire-damp in the localities where blasting had to be carried on.

From time to time assertions have been made as to the supposed comparative safety of different explosive agents more or less analogous in composition to blasting powder. It is not difficult to put the validity of such assertions to the test by chemical examination of the particular explosive preparations, and it may be confidently maintained, from the experience which the Royal Commission and the author individually has acquired of preparations of this class, that there are but very few practically useful explosive agents of the gunpowder type which possess any advantage in point of comparative safety over ordinary black or blasting powder.

The employment of powder in the compressed form, which has of late years become very extensive, presents important advantages in point of convenience and general safety of handling, but does not in any way affect the dangers in reference to use in coal mines, inherent in an explosive agent, the employment of which is liable at any time to be attended by the production of considerable volumes of flame. Attempts were made, in the earlier days of the history of gun-cotton, to apply that material as a blasting agent in coal mines, but the circumstance that its explosion is attended by the development of a large proportion of carbonic oxide renders it inapplicable in this

direction, as its explosion (even by detonation) is liable, on that account, to be attended by the production of a considerable volume of flame. Finely divided gun-cotton may be readily incorporated with the proportion of a nitrate (saltpetre, or barium nitrate) necessary for the complete oxidation of its carbon, the generation of carbonic oxide being thus prevented or reduced to a minimum; and such preparations as nitrated gun-cotton, tonite or potentite, produced by compression of mixtures of this class, have found favor to some extent in drift work, or in the blasting of stone over and underlying coal seams, as being more powerful than powder; but their explosion is by no means unattended with the possibility of the development of flame. In this respect nitroglycerine preparations are undoubtedly superior. This explosive agent contains a proportion of oxygen slightly in excess of that required for the complete oxidation of its constituent carbon, hence its perfect explosion is unattended by the development of inflammable gas. The most common form in which nitroglycerine is commercially employed is as dynamite. When exploded by detonation, the heat developed by the metamorphosis of the nitroglycerine raises the mineral matter present to a bright red or white heat, and the detonation of this preparation is always attended by the appearance of sparks in the dark. But if even the undiluted nitroglycerine is exploded in a shot-hole, the high temperature has the effect of raising to incandescence, particles of the tamping employed, or of the coal or stone exposed to the highly heated gases and vapors developed, so that under any circumstances sparks would be liable to be projected on the firing of a nitroglycerine charge. The same holds good with any of the nitroglycerine preparations known in commerce, such as lithofracteur, blasting gelatine, or gelatine-dynamite; moreover, flame in more or less abundance may be produced by the explosion of some nitroglycerine preparations, the composition of which includes proportions of inflammable materials.

That the heat to which very finely divided solid particles may be raised, by exposure to the highly heated products of detonation of nitroglycerine preparations, is sufficient to determine the ignition of an explosive fire-damp mixture, has been amply demonstrated by experiment, and it is even possible that sparks sufficiently hot to produce that result may be carried to some distance by the blast of heated gases projected by a shot, and thus reach places at some distance from the shot-hole where gas may have lodged.

The author's long connection with the study of explosives and their application to every variety of use, naturally led to his special devotion of much attention to this branch of its investigations; and the first idea bearing upon the occurrence of casualties in coal mines which suggested itself to him was to apply the principle of most complete explosion, or detonation, of one or other of the so-called "high explosives" (chemical compounds highly susceptible of sudden metamorphosis into gaseous products or vapors) in conjunction with the method first devised by him in 1873, and communicated in that year to the Royal Society, of distributing the operation of the force developed by small charges of the explosives over a considerable area, through the agency of a comparatively large volume of water, by which the charge is enveloped.

The principle of suddenly transmitting the force of detonation of a charge of explosive uniformly in all directions, by completely surrounding with water the charge to be detonated, had already been successfully applied by him to the conversion of an ordinary shell into a projectile operating with the destructive effects of a shrapnel shell, and to several other purposes, and it occurred to him that by applying the same principle to the charging of a shot-hole, the effect might be not only to modify the destructive action of a high explosive, and thus to attain a comparatively moderate splitting or rending action instead of powerful disintegrating effects, but also to accomplish the extinction, through the agency of the water envelope, of any incandescent particles or sparks, and perhaps flame, projected by the exploding charge, the water being thrown forward together with them in a finely divided condition. It soon afterwards came to the author's knowledge that Dr. McNab had previously put into practical execution the idea of extinguishing the flame of a powder charge projected from a shot-hole, by inserting a cylinder filled with water over the charge and confining it by a small amount of tamping. The application of water in this way, in conjunction with powder, was also expected by Dr. McNab to effect important economy of time in blasting operations, by diminishing the persistency of the smoke through the solvent action of the water, thereby enabling men to return to work in a comparatively short space of time after the firing of shot. The latter result appears to have frequently been attained to a useful extent, but experience showed, on the other hand, that sufficient reliance could not be placed upon the extinguishing effects of water thus applied in conjunction with powder being

sufficiently exerted to afford reliable security against the ignition by the flame from a blown-out powder-shot, of an explosive gas mixture, or of dust thickly suspended in air containing a small proportion of fire-damp. A series of experiments indicated, however, that water-tamping, as first suggested by Dr. McNab, used in conjunction with a high explosive such as dynamite, afforded very considerable, if not absolute, security against accidental explosions under the conditions just now specified.

An exhaustive series of experiments was instituted, chiefly in South Wales, with a view to ascertain whether perfect security against ignition of explosive gas mixtures, and of coal dust thickly suspended in air containing a small proportion of coal-gas or fire-damp, was secured by the application of high explosives in conjunction with water in the way suggested by Abel, the charge of explosive being enclosed on all sides by water, with or without the additional use of superposed tamping. The results appeared to justify the conclusion that the so-called water-cartridge, employed in conjunction with a high explosive, could be relied upon to afford security against accidental explosions during shot-firing in the presence of explosive gas mixtures, or of very inflammable coal dust thickly suspended in air containing some small proportion of fire-damp. The results obtained for the Royal Commission have been confirmed by experiments of a similar nature pursued by others in this country, by experimenters in Saxony, and by members of the Prussian Fire-damp Commission. In the course of these various experiments it has been found that the particular form of dynamite to which the name gelatine-dynamite has been given, is especially suitable for employment in conjunction with water, as it retains its explosive properties unimpaired under these conditions, and may, in blasting operations, be placed quite unprotected, either in a shot-hole which is filled with water, or in a cylinder full of water of suitable dimensions for insertion into the hole. In constructing a water-cartridge there is not the least necessity for employing any device for keeping the explosive in such a position that its circumference is surrounded equally on all sides by the water; it suffices simply to insert the charge with its waterproofed fuze or wires attached, into the blast-hole direct (if the latter is in perfectly solid stone or coal and in a suitable position), or into the cylinder of thin sheet metal, varnished paper or membrane which is filled with the water; it is best, however, to insert the charge nearly to the bottom of the water, so as to utilize the tamping effect

of the greater part of the column. The liquid is retained by a wooden or cork plug, through which the fuze or conducting wires pass, and tamping is applied over this after insertion of a tuft of hay or other suitable padding material.

The work done in coal by a high explosive, through the agency of a column of water which encloses it (or "water-cartridge"), is different in character to that accomplished by the same charge used in the ordinary manner. Instead of exerting a crushing action immediately round the charge, whereby much small coal is produced and no large amount of displacing work performed, the force being distributed over the whole area of the water column, its action is thereby greatly moderated, and the coal is brought down in large masses, the work done extending over at least as large an area as that of the best powder-shots.

In applying this system as a safeguard against accidental ignition of coal dust or fire-damp mixtures, the quantity of water used should at least amount to four times the volume of the charge employed.

It has come to the knowledge of the author that, in a colliery where a serious explosion recently occurred, so-called water-cartridges were in use, in which, when the charge of explosive had been inserted, very little room was left for water. From the published account of the evidence given at the inquest, it appeared to have been affirmed that Abel's water-cartridge had been used at a great expense, and it was left to be implied that the calamity was due to confidence being falsely placed in the safety to be ensured by its employment.

The practical development of the principle of applying water in conjunction with high explosives cannot fail to be fruitful of improvements in the mode of operation, as indeed it has already been; thus, in order to avoid a loss or diminution of the safeguard furnished by the water from the escape of the liquid through channels or fissures in the shot-hole, or through leaks in the water-cylinder or cartridge, it has been proposed by Messrs. Heath and Frost to dissolve sufficient size or glue in the water, warmed for that purpose, to make it solidify on cooling in the case or shot-hole to a sufficiently stiff jelly to prevent such escape. Again, the experiments carried out for the Commission with water-cartridges led to the observation that a considerable proportion of the water was driven forward in a body instead of being dispersed in a very fine state of division, by the force of a blown-out shot, and a suggestion was consequently made

for the employment of the water in a different manner, which was worked out by Mr. Galloway with most successful results, so far as related to the extinction of flame and sparks from a blown-out shot. By distributing the water through a very porous body (such as sponge or moss), and thus effecting an initial interruption of continuity of the mass of liquid placed over the shot, its thorough dispersion in a very finely divided condition is ensured, and its extinguishing power is greatly increased. It was found, in a number of experiments at the Dowlais works, that in holes of 2 inches diameter, the placing of 9 inches of loose tamping of moss soaked with water over a 4-oz. charge of dynamite sufficed to prevent the ignition of dust-laden air containing coal-gas by the blown-out shot, and that such a shot produced with 2½ oz. of dynamite, the charge being covered with only 4 inches of loose moss and water-tamping, failed to fire an explosive gas mixture. A number of comparative experiments demonstrated that the water-cartridge was on an equality with moss and water-tamping in preventing the ignition by blown-out shots produced with dynamite, gun-cotton, tonite and gelatine-dynamite, of a dense cloud of highly inflammable dust suspended in air containing a small proportion of coal-gas (the cloud produced under the same conditions being invariably inflamed by an ordinary blown-out dynamite shot); but they proved that the water-cartridge did not afford that absolute security against the ignition of an explosive gas mixture by a blown-out dynamite shot that, so far as a number of consecutive experiments showed, was attained by the comparatively simple moss and water-tamping, which can be applied without difficulty even in holes having an upward inclination.

The water-cartridge employed with various high explosives in such a way as to produce blown-out shots in the presence of coal dust and gas, has been made the subject of official experiment in Prussia and Saxony, and apparently with results as satisfactory as have now been obtained in different mining districts in this country; it may be considered to have been conclusively established that the application of water in the shot-hole in one or other of the ways indicated, in conjunction with the use of high explosives, affords most important security against accidents in blasting stone or coal in mines where dust and fire-damp co-exist.

It may be well again to emphasize the fact that neither the water-cartridge nor water-tamping applied in the manner in which it has been found so thoroughly efficient in conjunction with high explo-

sives, affords any safeguard against explosions arising from the presence of fire-damp, or coal dust associated with fire-damp, in mine workings where blasting is carried on, if powder, or any explosive agent analogous in its composition and mode of explosion to powder, be employed in conjunction with them.

Suggestions have been made to use in conjunction with powder, or as tamping over the charge, certain solid preparations which will evolve gases or vapors, when exposed for a sufficient period to heat, capable of extinguishing flame, the idea being that the heat developed by the explosion of the charge would accomplish the desired results, and that the dangers arising from blown-out shot might thus be guarded against; but the authors of these suggestions have not realized the importance of time as a factor in the establishment of chemical changes by the action of heat, and the consequent impossibility of gases and vapors being evolved, in the desired manner, within the exceedingly brief period during which the materials applied are exposed to heat. The Commission, at the author's suggestion, had experiments carried out for the purpose of ascertaining whether condensed (liquefied) carbonic acid could be applied in suitable tamping vessels, in conjunction with high explosives, as an extinguishing agent, but the results were not sufficiently encouraging to warrant perseverance in this direction of experiment.

Some attention has been attracted since the publication of the Commission's final report, by a safety blasting cartridge brought forward by Dr. Kosmann, of Breslau, which depends for its action upon the rapid development of hydrogen under high pressure from very finely divided zinc, by the action of sulphuric acid (enclosed in one compartment of a compound vessel of glass). The acid is intended to have access to the zinc after the apparatus has been fixed into the shot-hole, in such a way that the gas, which is said to speedily attain a high degree of compression, shall exert its force upon the stone or coal. The cost of each shot is stated to be only small, but the description scarcely warrants the view that the arrangement is a practically efficient one, and no account of successful experiments with it in actual blasting operation has yet reached the author.

Various proposals to apply compressed air to the getting of coal have been put forward, among which was one by Mr. Samuel Marsh, of the Clifton Colliery, Nottingham, to the practical development of which Mr. Ellis Lever devoted much trouble some years

ago, but no really satisfactory results appear to have been attained with it.

The considerable increase in volume which caustic or quick-lime rapidly undergoes during the slaking process (or its conversion into hydrate by union with water), was already many years ago regarded as a source of power which might be available in lieu of powder for the bringing down of hard coal; but repeated attempts to utilize it met with no practical success until Messrs. Sebastian Smith and Moore, about six years since, made two important steps in advance. In the first place, by reducing freshly burned fat lime of high slaking power to powder, and converting this into cylinders by applying powerful pressure, they obtain the lime in an exceedingly compact form, which enabled them to utilize the full diameter of a drilled shot-hole, and which rendered the material less liable to air-slaking than when in lumps. In the second place, using the heat developed by the slaking to generate and superheat steam, they were able to supplement to an important degree the force exerted by the expanding charge of lime. The author then details the results which have been obtained in the use of the lime-cartridge, and notes some of the disadvantages which are held to accompany it.

Scribner's Magazine, **3**, 563-576, May, 1888, contains an article by Charles E. Munroe, on "Modern Explosives," in which the author has sought to present, in a popular and yet precise way, the theory of explosion, and to describe the characteristic properties and method of use of some of the more typical explosive substances. The author calls especial attention to this article, as it shows that he does not endorse many of the statements which he collates in these Notes.

The paper is well illustrated, principally from photographs and objects prepared at the Torpedo Station. The illustrations of the effects produced by detonating gun-cotton on iron plates show that the theory which he has presented in these Notes* is confirmed by further experiments, for, as shown, he has bored holes of continually increasing diameter and depth in gun-cotton disks until he has pierced one completely with a hole two inches in diameter, and on detonating these on the iron plates he has obtained deeper and deeper indentations in the plates, until, when using the completely perforated gun-cotton disk, he has completely perforated the plate.

* Proc. **11**, 110; 1885, and **13**, 594; 1887.

This theory is further supported in a paper by the same author in a paper published in *Proc. Newport Nat. Hist. Soc.* No. 6, 18-23; 1888, entitled "On certain Phenomena produced by the Detonation of Gun-cotton." He used a can such as is used for canning fruit and vegetables, placed a disk of gun-cotton in it, filled the can with sufficient water to just completely cover the disk, placed the can on an iron beam, and detonated the gun-cotton by means of a dry priming disk. The can was of such a diameter as to just receive the disk, and the end of the can in contact with the beam was the one through which the can had been filled with its fruit, and as is the case with such cans, the end had a sunken circular channel let into it, and an irregularly shaped mass of solder at the center of the face which was raised above the surrounding surface. On examining the face of the iron beam on which the detonation took place, an impression of this end of the can, with all the depressions and elevations having precisely the same value as in the original, was found to have been exactly reproduced in the iron of the beam. This is well shown in a photo-stereotype attached to the paper.

The author has also succeeded in obtaining "Wave-like Effects produced by Detonating Gun-cotton," by using a tin vessel with a smooth bottom in which to hold the explosive. The can in this case had a diameter much larger than that of the gun-cotton disk; the disk was placed on one side of the can so that the cylindrical surfaces were tangent, and the can was filled with water and detonated on an iron beam just as described in the last experiment. On examining the impression produced on the beam there was found, as was to be expected, a deep impression under the area occupied by the gun-cotton, but, as was not to be anticipated, *the impression extended less deeply quite to the extremity of the area marked by the base of the can.* But what was yet more remarkable was that beneath this crescent-shaped space between the peripheries of the disk and the can which had contained only water, *two sets of breakers had been produced in and remained fixed in the iron*, the crests of the waves being turned outwards. The exterior set of breakers consisted of waves which were easily visible to the naked eye and sensible to the touch, and their average wave-length was found to be closely 1.5 millimeter. The author hopes to be able by this method to distinguish between different explosive substances, and to learn more regarding the nature of explosive phenomena and the way in which

the energy is propagated. A description of the experiment appears in *Am. Jour. Sci.* **26**, (3), 49-51, July, 1888, with diagrams showing the method of experimenting, and an exquisite photo-stereotype of the iron beam.

The theory which we have offered regarding the way in which the indentations are produced by gun-cotton on metal plates is strongly supported by M. P. F. Chalon, in *Le Genie Civil*, in an article entitled "Mining without Tamping," and he extends the theory to the phenomena taking place in a drill-hole. We are indebted to him for a copy of this article, which we reserve for a later date.

"Les Explosifs Modernes," by P. F. Chalon,* is a theoretical and practical treatise prepared for the use of civil and military engineers and miners, which appears in the form of a large octavo of some four hundred pages, with upwards of one hundred and sixty figures intercalated in the text. The matter is well arranged and so treated as to make this an excellent manual as well as a work of reference. While sufficient space is given to the properties of the substances which may be employed in the manufacture of explosives, to the methods of manufacture and properties of the more important explosives, to the methods of analyzing and of testing the force of these explosives, and to their uses in peace and war, yet some fifty pages are devoted to the legislative acts in Austria, England, France, and the United States, which regulate the manufacture, transportation, storage and use of explosives in these countries. This information, which is so important, but which it has hitherto been difficult to gain access to, apart from the other merits of the work, makes this book a necessary one to possess.

"La Dynamite de Guerre et le Coton-Poudre," by Max. Dumas-Guilin,† treats of the manufacture, transportation, storage and use of these explosives according to the orders and regulations which govern the French army concerning them. As, besides giving these regulations at length, its matter is largely drawn from the courses of instruction at *l'Ecole de Guerre* and *l'Ecole du Genie de Versailles*, the work has almost the authority of a Blue Book. As might be expected from this, we find minute and detailed descriptions of the methods to be followed in the service during storage, transportation,

* E. Bernard et Cie., Paris, 1886. † Henri Charles-Lavauzelle, Paris, 1887.

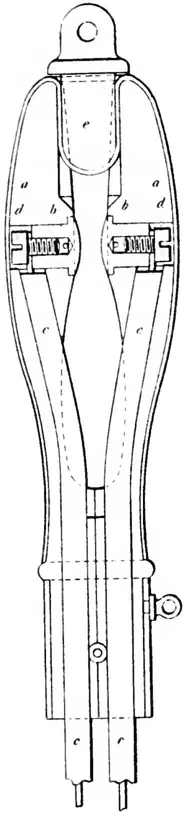
and use of the explosives mentioned, both in times of peace and war; the treatment of the topics of military mining and the destruction of material being especially full and explicit. The book contains about four hundred small octavo pages, with about fifty figures in the text, and is of a convenient form for a manual for use in the field. As will be seen from the description, the book is one which commends itself especially to officers of the navy and army.

M. P. F. Chalon also presents "Le Tirage des Mines par l'Electricité,"* in the form of a small octavo of two hundred and seventy-six pages, with ninety figures and numerous tables. The book deals both with the theory and practice of firing mines by electricity, and describes at length the different blasting caps and detonators, the electrical firing apparatus, both batteries and machines, and the methods of wiring mines for large blasts.

"Die Elektrische Minenzündung," by Karl Zickler,† is an octavo pamphlet of one hundred and sixteen pages, with sixty figures, and with tables, which deals more briefly with the subject treated of by Chalon in the last mentioned book.

R. Gaertner, of Berlin, announces the publication of "Die Fabrikation von Chlorsauren Kali und anderen Chloraten," by K. W. Jurisch, Ph. D.

* Baudry and Cie., Paris, 1888. † F. Vieweg & Sohn, Brunswick, 1888.



a, two pieces of hickory.

b, brass contact stud.

c, leading wire.

d, screw.

e, safety pin.

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PROFESSIONAL NOTES.

HAND FIRING KEY.

[Invented and manufactured at U. S. Torpedo Station.]

The firing key consists of two pieces of hickory, shaped to fit the hand, and joined together at the smaller end. Each piece is fitted with a brass contact stud, projecting from its inner face at a short distance from the larger end. The natural spring of the wood keeps the two parts separated and maintains, normally, a break between the studs. A hole, bored longitudinally in each part, permits the entrance of a leading wire, the bared end of which is secured by a screw to the contact stud. A rubber cot is seized over the key at the smaller end. The cot fits neatly and encloses the entire apparatus, preventing sea-water from entering and making a circuit from one stud to the other. A safety pin attached to the key by a chain is habitually kept between the two parts, to prevent accidental closing.

The hand firing key, introduced in an electrical circuit, provides a break that can be closed at will. It is intended for use either in firing torpedoes or in individual gun practice. One of these keys was submitted to the Bureau of Ordnance in April last and was approved for issue to the naval service.

C. E. M.

ALFRED KRUPP: A SKETCH OF HIS LIFE AND WORK.

[After the German of Victor Niemeyer. A review by K. W. and O. E. Michaelis. New York: Thomas Prosser & Son, 1888.]

Alfred Krupp was born in Essen-on-the-Ruhr on the 12th April, 1812. At the age of fourteen he received as a legacy from his father the secret of making cast-steel, and soon afterwards, in accordance with the provisions of his father's will, he assumed the management of the steel works at Essen, which had been established in 1810.

The growth of the Krupp Works from the small water-driven forging plant to the present "Kingdom of Krupp" is an impressive illustration of human possibilities. The present enormous plant is an ultimate development extending over a period of nearly three-quarters of a century, and is the result of indomitable application directed by rare genius and resolution. Krupp's early life was full of disappointments and stern vicissitudes. He entered upon a career which had sunk his father's fortune and broken his heart, with no other prospect than that of years of manual labor. "Working hard," he says, "often all night long, my food being for the most part potatoes, coffee, bread and butter, but no meat, I felt all the responsibility of a harassed father of a family. For twenty-five years I persevered, until at last, under gradually improving circumstances, I conquered a decent living. My most vivid impression of the distant past is the recollection of the long-continued, ever-threatening dangers of ruin, and its avoidance through patience, self-denial and labor. With this I am anxious to encourage every young man who has nothing, is nobody, and wants to be something."

In the beginning the output of the works was limited to tools, mint-rolls and dies, shears, etc. The Düsseldorf Mint was one of the main customers, and later, after defeating the opposition of his competitors in Vienna, large orders were received from the Austrian Mint. Alluding to the anxieties of his few months' residence in Austria at the time he was soliciting the patronage of that government, Krupp used to say, in speaking of his white hair, "I left the color in Vienna."

His most important inventions were the cast-steel roller-die and an ingenious process for manufacturing unwelded railroad tires. These inventions brought him distinction and wealth, and he was enabled to considerably enlarge his works.

But it is upon his system of ordnance that Krupp's fame more largely rests, although he did not turn his attention to the subject until 1846. In 1847 he exhibited a small steel gun at Berlin which does not seem to have been very much noticed. During the next ten years he was chiefly engaged in the manufacture of steel for commercial and railroad purposes. The growth of his works was stupendous, and he began to attract the attention of other countries. Honors poured upon him from home and abroad; he was made by his own king, Privy Commercial Councillor, but he persistently declined patents of nobility. He was a man of the people, and always insisted upon being addressed as a plain citizen.

Nearly ten years after the Berlin Exhibition, Krupp sent a 12-pounder to the Paris Exposition; it attracted much attention and led to exhaustive trials of his systems. He was now fairly committed to the construction of guns, and following an order from Egypt, the first large order for his guns he received, the demand for them steadily increased. Since those days of experiment the Krupp gun has developed astonishingly, until now it would appear as if it had reached its limit in the 40 cm. gun which weighs about 139 tons. During his thirty years of ordnance work Krupp delivered a total of 23,000 guns to thirty-four different States.

With the growth of the plant and the increase in the number of the workmen, Krupp set himself to the solution of that most difficult social problem, the improvement of the workmen's condition. Inspired by his own humanity and a deep-grounded sympathy for them, he elaborated a system of regulations, comprehensive and almost perfect in its details. Sick funds, accident insurance, and retiring pensions were established; schools were founded; a commissariat was organized, by means of which the workmen were not only protected from usurers, but were prevented from running into debt. Cottages were built for the married employes and let at a nominal rent, and a "commons" was erected for the unmarried.

The welfare of his employes was his first consideration. He was father to them as well as governor, and his relations with them recall the patriarchal age of the world. It is given to few men to bring their life-work to such a successful issue, and it may be written of him as it is written of one of old, he died full of riches and honor. A. G.

KRUPP AND DE BANGE.

A Review.

Krupp and De Bange. By E. Monthaye, Captain in the Belgian Staff. Translated, with an Appendix, by O. E. Michaelis, Ph. D., Captain of Ordnance, U. S. A. New York: Thomas Prosser & Son, 1888.

Captain Monthaye's monograph is a presentation of the arguments advanced by the advocates of the Krupp and De Bange gun-systems, prompted by the desire "to re-establish the truth and to restore to the Essen constructor of

ordnance that pre-eminence which is his just due." Captain Monthaye insists that his aim is to submit the question impartially from a neutral standpoint, but it is evident, from the avowed object of the book, that he is himself a too devoted disciple of the "Cannon King," for his conclusions to be accepted without reservation.

His argument that crucible steel is the best gun-metal on account of its homogeneity and hardness (and consequent resistance to erosion) will doubtless pass unquestioned. With the exception of the Firth crucible steel used for gun-tubes in English ordnance, steel by this process is not used for guns by any builders, other than Krupp, on account of "its expense, and the great care and arrangement necessary for very large ingots, when great numbers of men must be carefully trained to work together." Guns as a rule are made of open-hearth steel.

The question of *matériel* having been disposed of, Captain Monthaye next compares and discusses the two systems of breech-closure, obturation, and gun construction. He claims for the Krupp wedge the following advantages: that the wedge, working perpendicularly to the axis of the gun, cannot be blown out in imperfect locking; that it bears, not against the body of the gun, but against a jacket shrunk on the gun; that the gun can be aimed as soon as the charge is inserted, and that it has fewer parts and is simpler and easier to work in large caliber than the De Bange screw-block.

The wedge system necessitates increased length of breech and adds greatly to the weight of gun, a fact which gives rise to a marked difference between German and French ordnance as a whole; the former being distinguished by heavy guns and light carriages, which is just the reverse of the French system. On this point the author says: "The initial velocities of corresponding guns of the two systems vary within rather narrow limits, easily explained, as the weights of the charge and projectile are about the same. At first sight, then, it would appear that the lighter De Bange gun is more effective; but when we compare, as the *ratios of effect*, the total energies divided by the total weights of gun and carriage, we find that the Krupp guns exceed the De Bange by from 16 to 30 per centum."

Captain Monthaye considers the Broadwell ring "which is firmly seated at the end of the gun-chamber and presses tightly against the gas-plate (let into the front face of the wedge) when the wedge is locked," the simplest and best form of obturation. He is of the opinion that the asbestos packing in the De Bange system will not long keep its moulding qualities, that it is subject to climatic influences, liable to injury, and that it is more difficult to replace than the Broadwell ring. Whatever may be the defects of the De Bange pad, pure and simple, its efficiency as a gas-check in the modified form adopted in this country and England is a matter of every-day experience. After a full trial, this system was adopted in England in 1882 for all guns of new type not then issued to service. Some pads have been known to last a thousand rounds, and it is not probable that, except in field-pieces, the firing could be rapid enough to warm the pad to deformation. If it should, it can be easily replaced, as spare pads are furnished to every gun.

As regards construction, the Krupp guns consist of a steel tube strengthened by a jacket and hoops; the jacket, as stated above, carries the fermature, thus relieving the tube of the direct longitudinal strain. The De Bange hoops have a double taper, and the breech-block screws into the tube. "In practice, the taper, limited in one direction by the width of the hoop and in the other by the pressure which the exterior is to exert upon the interior hoop, becomes practically so slight, that the tube in which the breech-screw is situated may be torn apart with sensible displacement of the hoops. If the tube be once broken, unbreeching will as surely ensue as with cylindrical hoops. Furthermore, the perfect matching and shrinking-on of two conical surfaces, as demanded by Colonel De Bange, is almost a mechanical impossibility; at all events it cannot be done by usual shop methods."

It may not be out of place to note here that the steel guns recently constructed in the United States are not De Bange guns, but are fitted with a modified De Bange obturator, and, as the translator remarks, "the French fermature is applied to our guns from necessity rather than choice."

That accidents have happened to only twenty-five guns out of 23,000 manufactured by Krupp is an evidence of excellence which needs nothing more to emphasize it.

The official firing data compiled and compared by Captain Monthaye show the superiority of the Krupp ballistics, and he further states that two siege Krupp guns of 10.5 cm. and 12 cm. caliber were fired for endurance about 1000 rounds each, "with no perceptible scoring or diminution of accuracy." He concludes his argument with an interesting account of a visit to the works at Essen.

Notwithstanding its strong bias, which detracts somewhat from the value of the book as final and authoritative, it is full of important information, and forms a desirable addition to the increasing literature of the gun question.

A. G.

THE NAVAL DEFENSES OF THE UNITED KINGDOM.

By Rear-Admiral P. H. Colomb.

[From Journal of the Royal United Service Institution, No. 144.]

A Review.

This paper of Admiral Colomb's, with its discussion, opens a subject which is of vital importance to us on this side of the ocean. He advocates a strong naval defense, as opposed to one which relies mainly on strong fortifications. He says: "I am desirous of raising a discussion on the purely naval or active defenses of the United Kingdom, which it seems highly necessary should take place at the present juncture. I think it the more appropriate that we should have a discussion, as looking roughly back over our journals I easily count up some seventeen papers on the military defenses of these islands, but only four which can be said in any way to touch the naval defenses, and I think there is only one—that by Rear-Admiral Scott, in 1877—professing to deal with them, which has come from the hands of a naval officer. But of these four I do not find one which lays out any principles of naval defense."

Are we not treating the defenses of our coasts in somewhat the same manner? Many of our magazines have papers on the military defense of our coast, but there has been little or nothing as to a naval defense in any magazine, even our own Proceedings, except the prize essay of 1881 by Lieutenant E. W. Very.

The Admiral believes that there are but two systems of naval defense: that of blockade, viz. the maintenance of a squadron at sea in close touch with an enemy's squadron in port—Lord St. Vincent's system; and that of concentration at and near the home ports—Lord Howe's system. He combats the idea of the impossibility of maintaining an efficient blockade, by showing the success of our blockade of the southern coast during our late war, quoting from "The Blockade and the Cruisers," by Prof. J. R. Soley, U. S. N. Throughout his paper he presupposes that Great Britain must have a superior naval force, and in that particular, the situation from which he argues against spending money in fortifications that might otherwise be used for the naval defense, hardly applies to our case. But in other points he touches our position more closely. He quotes Colonel Ardagh, who says, "It would be perfectly preposterous to employ an ironclad to defend a port when you could construct a fort at one-twentieth of the cost of the ironclad, and put one-sixth of the *personnel* into the fort to defend it," and then answers him—"If on any line of coasts of these kingdoms

there were twenty ports, each port requiring to be defended by something equal to a single ironclad, which plan would be cheapest, to build twenty forts, each equal to an ironclad in power, or to build one ironclad and station her in the middle of the line of coast?" In an article in the *American Magazine* entitled "Our Defenses from an Army Standpoint," Gen. O. O. Howard, U. S. A., adopts a similar view to that of Colonel Ardagh, and makes a comparison between the cost of mounting and protecting a gun on shore and one afloat. Again, the point arises in the paper by Lieut. E. M. Weaver, "The Armament of the Outside Line of Defense," in the Journal of the Military Service Institution, No. 34. In the discussion of this paper Captain A. T. Mahan, U. S. N., says: "I think there is a tendency to undervalue the protection a ship derives from her constant motion and from the difficulty of the gunners knowing her exact position at the moment of firing. If bombardment promises adequate military results, the power of the biggest guns on shore to control ships at six miles distance may be doubted"; and Commander W. T. Sampson, U. S. N., says in the same discussion, "It is not unlikely that military men undervalue the peculiar advantage of a gun afloat. The instability and destructibility of its platform are disadvantages. On the other hand, its mobility is a most comprehensive advantage."

To return to the Admiral's paper, it is evident that he does not intend to do away with fortifications altogether, but only to have the main dependence placed in the naval defense, and to use fortifications only to provide against attacks made by small forces, or dashes. He says, "In no case ought a naval strategist, having to defend the ports and coasts of these islands by naval means, to think of a separate naval defense for separate ports when the attack is of a serious character and requiring time for its accomplishment." In the discussion, Captain W. H. Henderson, R. N., gives the following as the views of those who agree with Admiral Colomb: "1st. A navy strong enough to hold command of the sea; this insures protection from territorial attack, from invasion, and offers the utmost possible protection to our commerce. Of equal importance must be an army capable of holding the northwestern frontier of India, and possibly of the frontier of Canada. 2d. An active army ready to deliver a counterstroke whenever it may be required. 3d. Such military defense of the coaling stations, some commercial ports, and some strategical points, as will secure them against the operation of raiders. The amount of this defense will depend on the strength of the navy; an active naval defense being the best, a local naval defense second best, and passive military defenses the weakest for the purpose. 4th. Organization of the militia and volunteers as a field army, as a check to the possibility of an attempt at invasion. 5th. And only if the navy is too weak for its work, such military defenses to the arsenals and some ports as will render them secure against combined naval and military attack in force."

In his closing arguments the Admiral says: "Speakers have not understood what the history of the question of what we are beginning to call a flanking fleet is. They have not understood that if there were such a thing as an ironclad fleet at Portland, that that is an absolute protection for every part of the coast of England against a large organized hostile attack until it is itself beaten. I say that, because naval history tells it in every page. It has always been the case. Right through from the very beginning of naval war, officers, when they have proposed to make attacks on territory, have had to abandon them because they have heard a mere rumor that there was a fleet at sea. In the case of the Spanish Armada, as has been pointed out by Professor Laughton, if Medina Sidonia had masked the English fleet in Plymouth, the chances are that invasion would have succeeded. What really prevented it from succeeding was the action of the English flanking fleet. It was impossible to carry out the invasion in the face of that fleet. Again, at the end of history, you have Persano, the Italian Admiral, doing precisely the same thing. He goes to bombard Lissa, and is preparing to land, not having masked the

Austrian fleet. In the middle of his operations the Austrian fleet comes out, and we know the result. But all through history you can find that this action of the flanking fleet is a complete defense, and down to what we must call the other day it was so. The French fleet in the Baltic, during the Franco-German war, twice prepared to bombard Colberg. Colberg is a town on the southern coast of the Baltic, a fortified town which was to be bombarded by the ironclad fleet and nothing else, and with no preparation. Therefore there was no trouble about it, no organization had to be taken in hand. They intended to bombard this, made all their preparations, and were about to put to sea to do it, when they heard a false rumor that the blockade of the Jahde was raised. Instantly they postponed it, although the German fleet at the Jahde was much inferior to theirs, and although it was 600 or 700 miles off. A second time, some weeks afterwards, finding that this was a false rumor, they proceeded actually within 150 miles of Colberg, all ready to bombard it, when they heard a second time truly that the blockade of the German fleet was raised; they immediately dropped it. They dared not undertake even the light business of the simple bombardment of a coast town, because there was the neighborhood, 700 miles off, of a German fleet. If that were an isolated case, I should not speak so strongly, but it is not an isolated case."

While we are not likely to have a fleet of sufficient strength to adopt either method of naval defense advocated by Admiral Colomb, it is possible for us to draw some valuable lessons from his paper. Are we not in danger of ignoring the great advantage due to the mobility of a ship? And may not a fleet of ironclads, a flanking fleet, be not only a necessary and valuable part of the defense of our coasts, but also have its economical advantage by enabling us to dispense with some of the expensive fortifications which would otherwise be required for protection. The naval view of our defense should be brought forward, and in considering any system to defend our coast, the naval and military defense should be considered together, and in that way we would have a practicable defense with the smallest expenditure of money. R. W.

CARRIER PIGEONS.

Portugal has recently followed the example of the principal European governments, by organizing a military carrier-pigeon service. An order has been issued to establish carrier-pigeon stations at Lisbon, Oporto, Tancos, Vendas Nowas, Elvas, Mafra, and various other places.—*Deutsche Heeres Zeitung.*

The New Hampshire Naval Homing Pigeon Loft is situated at the training station in the harbor of Newport, R. I. The loft measures 18 × 14 feet, inside measurement, and was built under the direction of Lieutenant Nichols, assisted by Mr. J. W. Bolton. Several pairs of excellent homers have been presented quite recently by gentleman fanciers who have become much interested in the success of the enterprise.

This will be the nucleus of a loft of pigeons to be trained for naval purposes, and marks an era in the United States Naval Service. H. M.

BOOK NOTICES.

CATALOGUE OF THE EXHIBIT OF THE NAVY DEPARTMENT AT THE CENTENNIAL EXPOSITION OF THE OHIO VALLEY AND CENTRAL STATES, 1888. Lieutenant Richard Rush, U. S. Navy Representative. Printed by direction of the Secretary of the Navy.

This catalogue, prepared by Lieutenant Rush and assistants, Ensigns A. B. Clements and John Gibson, contains a list of the bureaux and offices of the Navy Department and Naval Stations making contributions to the exhibit; also a complete list of the contributions, with clear and concise descriptions of the more important exhibits. The arrangement is admirable, and the catalogue contains much information regarding the work of the Navy, in a very compact form.

FRENCH READER FOR THE USE OF NAVAL CADETS, U. S. NAVAL ACADEMY, Annapolis, Md., June, 1888. Press of Isaac Friedenwald, Baltimore, Md.

This is a professional French Reader for the use of Naval Cadets, which has recently been prepared and published by the Department of Modern Languages of the Naval Academy. It consists of extracts from *La Revue Maritime et Coloniale*, and is followed by a short vocabulary of professional terms. The Reader is well adapted for the instruction of Naval Cadets, as from it they may become familiar with that portion of the French language which will be most useful to them in their future career. The typography is excellent, as all who are familiar with the works issuing from the press of Isaac Friedenwald would expect.

THE BATTLE OF THE SWASH AND THE CAPTURE OF CANADA. By Samuel Barton. Charles T. Dillingham, New York, N. Y.

This brochure is of the prophetic style that has been quite popular since the "Battle of Dorking" appeared, with those who desire to convey a lesson and at the same time afford information to their readers. The Battle of the Swash occurs in 1890, in the outer harbor of New York City. A description is first given of the condition of the United States prior to 1890, in which the decadence of our merchant marine engaged in the foreign trade, and the condition of the Navy, is given. Then come the causes which lead to the war, showing the relations between Canada and the United States, especially in regard to the fishery question. War is brought on by a collision between some of the New York militia and a party of Canadians, both intent upon capturing a body of Fenians. The English fleet arrives off New York, but is driven off by a novel design of torpedo-boat. The fleet returns and bombards the city. Peace is then purchased by the United States for $1,800,000,000, Canada becoming a portion of our territory. Moral.—Encourage the merchant marine by subsidies, build up the Navy and strengthen the fortifications.

BIBLIOGRAPHIC NOTES.

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E. H. Keiser has determined the atomic weight of oxygen by combustion of hydrogen occluded by palladium. He obtains the figures 15.949. H. N. Morse and W. M. Burton have determined the atomic weight of zinc by conversion to oxide of zinc distilled *in vacuo*. They find the atomic weight to be 65.269 (O = 16).

NO. 5, SEPTEMBER.

S. B. Newbury and W. P. Cutter, having found that the oil in modern lamps often reaches a temperature of 110°–112° F., *i. e.* above the legal flash-point (100° F.), have determined the relation of the flashing point of oils to their capability of giving violent explosions with air. They show that an oil heated above its flashing point is dangerous, and recommend the raising of the legal flash-point to 120° F.

C. R. S.

ANNALEN DER HYDROGRAPHIE UND MARITIMEN METEOROLOGIE.

16TH ANNUAL SERIES, NO. 6. Meteorological observations in Cumberland Sound, by Dr. Franz Boas, of New York. Contribution to the sailing directions for the west coast of Africa, by Commander von Schuckmann. Geographical position of several places on the east coast of Australia. Quarterly weather review of the German Naval Observatory, summer 1884. Minor notices: Earthquakes at sea. On the use of oil to quiet the water. Notices in regard to Pernambuco. Anchorage at Rio Janeiro. Navigation of Hainan Straits. The harbor of Tandjong Privok, near Batavia.

NO. 7. The daily and annual force and direction of the wind on the island of Lesina. Report of Capt. W. Hoffman, of the German bark Spica, on his voyages from Liverpool to Chittagong, and from Rangoon to Falmouth. Soundings on the east and west coast of South America, U. S. S. Albatross. The northerly gales on the German Baltic coasts on March 12 and 13 and October 24 and 25, 1887. Report on chronometers tested in the Imperial Observatory at Wilhelmshaven during the winter 1886–7. Minor notices: Earthquakes at sea. Description of the härbor of Estero Balza Arriba, St. Domingo, Nanusa, and Meangis islands. Battle post.

NO. 8. Investigation of the influence of the dynamos and wires necessary for electric lighting, on the compass at the Imperial Observatory in Wilhelmshaven, by Dr. Eschenhagen. Remarks about

Bibundi, west coast of Africa, by Commander Schneider, of H. I. M. S. Cyclop. Tocopilla and Duendes: report by Capt. Le Moult, of the German bark Oscar. Deep soundings and temperatures in the Indian Ocean. Method of deducing true daily meteorological averages, from observations taken at the hours 8 A. M., 2 P. M., and 8 P. M., by Dr. W. Koppen. Quarterly weather review. Report on the 11th competitive trial of chronometers held at the Naval Observatory during the winter 1887–8. Minor notices: Remarks on Angra Pequeña and Walfish Bay. Remarks on the river Maulmain. West coast of India, Bay of Bengal. Oil rockets and oil bombs. E. H. C. L.

THE ENGINEER, NEW YORK.

AUGUST 25, 1888. Suppose this was an American steamer!

The first excursion—it can hardly be called a trip—of the City of New York continues to excite a good deal of comment among engineers and constructors on this side, by reason of the singular course adopted in stopping the ship when one set of engines was intact and capable, as has been asserted, of driving the ship at four fifths of her speed. During the run to Queenstown a joint blew out of the main steam pipe; this was so situated that only two men could get at it to work, and it took them ten hours, it is stated, to renew the joint. No information can be had on the ship herself, and those in a position to know decline to say anything. It is impossible to say to what extent the ship was really put to work. Captain Watkins said he could not tell, but the engineer might. Chief Engineer McDougal said that the vessel being now in port the engine was out of his jurisdiction. Resident Engineer Clark consulted with other officials of the company and declined to give any facts, while the guards on the passage leading to the engine-room were doubled. Meanwhile machinists by the score were busy passing in and out with tools, and making no end of noise. . . . . The City of New York is to make twenty knots per hour and is under heavy penalties to do it. Her best effort was eighteen and one-half knots with 18,500 I. H. P. and engines making eighty revolutions per minute. She will have to increase her power to more than 20,000 I. H. P. to get the additional knot and a half, and to get 20,000 H. P. she has to increase her best efforts in the engine-room over eight per cent. . . . . There are on the City of New York sixteen Worthington steam pumps for feeding boilers and other service. These worked perfectly throughout the voyage, giving no trouble whatever. The pump which gave out was of foreign make and was a circulating pump. We take some pains to note this fact, as the bare announcement that a pump gave out might lead some to think it was of American make.

OCTOBER 6. Facts about the City of New York.

We have taken some pains to get the facts in regard to the trouble with the City of New York, the latest English steamer, and we derive what follows from an American engineer who came over in the ship on her last voyage. This gentleman is well known in both England and America and does not wish his name mentioned. In the opinion of our informant, the ship was put on the line too quickly and before the proper adjustments and supervision could be had, with the usual results. A very great disadvantage to the engineers is the noise in the engine-room, arising from the presence of dynamos, electric-light engines and auxiliaries generally. Our informant said that it only needed looms to rival a cotton mill in full blast. As a result, the action of the main engines cannot be heard, and any cutting or grunting of the cylinders is drowned out by the racket aforesaid. In view of the fact that the piston

valves on the high-pressure cylinder gave out (caused by the rings seizing and pulling the follower-flange off), which accident was followed soon after by a similar one to the valve of the second cylinder, the noise of the auxiliary engines seems to be a decided disadvantage, for under ordinary circumstances the piston valves should have given warning by their grunting that they were running dry. In addition to this primary cause of annoyance, to use a mild term for it, the bearings are said to have given trouble by heating. This latter we have no positive knowledge of, but assume it upon circumstantial evidence satisfactory to an engineer. The circulating pump failure, concerning which so much was said, is believed to be a bluff to satisfy the curious who know nothing about engines and to whom one reason is as good as another. There is nothing about a circulating pump to give constant trouble, and it is rather unjust to the makers, Tangye & Co., to make them the scapegoat for others' sins. A serious disadvantage is the main steam-pipe and its design. This, if we are correctly informed, is common to all the boilers in one main pipe, from which it diverges in a V to the port and starboard engines. The throttle on the engine which broke down would not shut tight, so that the bonnet of the defective valve could be removed; therefore the main stop-valve had to be closed on both boilers; even then such a volume of steam found its way into the main, that the boilers had to be blown off before it was safe to open the chest. . . . . The City of New York is still in the hands of her builders, not having been accepted by the owners, and engineers generally will sincerely sympathize with the builders' engineer, Mr. McDougall, in his arduous task. His lot is not a happy one, and he must be a man of extraordinary qualities to carry through all the trials and worries he has already experienced and which have been made public, to say nothing of others known to him personally only, which have not been made public.

Why old engineers dislike new ships.

The engineer who is assigned to a new ship just out of the shop has not a happy lot. Old engineers shun such jobs. Young engineers aspire to them; but after a few weeks they wish they had not. The reason is that there is too much work, anxiety and general worry, for which there is no pay beyond the ordinary salary, which could be earned much easier on an old ship. An engineer on a new ship falls heir to all the mistakes of the shop, bad jobs, bad fits, leaky valves, badly set valves, etc., etc., and he is made responsible for them. If the engines do not turn up as fast as they should, the chief engineer is interviewed at once; if they give out, he is called upon; if a valve-stem breaks, or a feed-pipe leaks so as to stop the ship almost; if the boilers do not steam, and the bearings get hot all over; if the vacuum is poor and everything out of sorts generally, the first man looked for is the chief engineer, and he is asked to explain why these things are so. He has to keep the peace between the builders and the owners, and he has to steer clear of falling foul of both. If he says the engines were not fit to leave the shop, the builders are down on him forevermore; and if he does not make the ship go, whether the engines are fit or not, the owners do not like him. This is why old engineers do not like new ships, and no one will wonder at them after reading the reasons above given. Where it is possible, the chief engineer should be assigned to the ship when the bed-plate is put in, and thereafter haunt it like a shadow. He could then follow the pipes from start to finish, and could see every job as it was before one part covered up another. In many cases this is done, and the builders, if they are sensible men and the chief engineer is like unto them, can assist each other very greatly. Engine-builders are always desirous of having their work go off successfully from the start, and will spare no pains to insure such performance where possible. A new ship is a good school for young engineers.

W. F. W.

THE ENGINEER, LONDON.

JULY 27, 1888. The City of New York.

It would be difficult, if not impossible, to find more admirable examples of the highest type of mechanical engineering than is supplied by the splendid main engines. They have been constructed throughout from the designs of Mr. J. Parker, who also designed the very different but equally admirable engines of H. M. S. Aurora, which we illustrate this week. Mr. Parker has brought to bear on his task a life-long experience. He was for some years second engineer of the great paddle-steamer Persia, with side-lever engines. .... Mr. Parker's familiarity with all the difficulties and trials which beset the sea-going engineer has stood him in good stead..... Nothing finer can be imagined than the working of these gigantic engines, with a piston speed of 800 feet per minute, certainly the greatest velocity ever attained by pistons 9 feet 5 inches in diameter. During the whole run around Ireland, lasting nearly 46 hours, not a drop of water was needed on a bearing, nor was there the least symptom of heating.

Triple expansion engines of H. M. S. Aurora (illustrated).

"The valves are of the piston type and are worked on a novel system invented by Mr. J. Parker, by whom the engines were designed. It is well known that heavy piston valves when worked at high speeds require to be fitted with cushioning pistons, to take up momentum at the end of the stroke and to prevent shock and jar in the eccentrics and link motion. Mr. Parker utilizes these balance pistons to work the valves, the link motion having nothing to do but control and regulate the action of the valves. To this end, what is known as 'kicker gear' is provided. When a piston valve approaches the end of its stroke, the 'kicker gear' opens a slide valve which admits steam to a cylinder in which is a piston on the same spindle as the piston valve. The effort of the steam would at once reverse the main valve, which would continue to reciprocate independently without reference to the action of the crank-shaft. This the link motion and eccentrics prevent. The result is that the eccentrics have very little to do, and the whole valve gear works without stress or heating even at the very high speeds adopted. This is a very valuable improvement in steam engineering."

AUGUST 10. Copper steam pipes for modern high-pressure engines.

Paper read before the Institution of Naval Architects.

AUGUST 17. On the steam trials of the Royal Italian ironclad Lepanto.

Paper read before the Institution of Naval Architects. The power developed was 16,150 I. H. P., which gave a speed of 18.38 knots; the displacement of the vessel at the time being 14,860 tons, and the mean draft 30 feet 4 inches.

Marine engines in the navy.

Editorial on the numerous and great failings shown at the naval manœuvres.

AUGUST 24. Bagshaw's diagram meter.

This is an instrument resembling a pair of compasses, with a small dial attached at the joint, and is used to get the mean pressure from indicator diagrams.

SEPTEMBER 14. Locomotive boilers at sea (editorial).

The reason why the type has failed hitherto at sea is, we think, easily explained..... The lines on which it must be proportioned, constructed and

used are very sharply defined. If we go outside them we shall be quickly reminded of the fact. But hitherto the locomotive boiler used at sea has not been like the locomotive boiler on land. The differences between the two are apparently trifling, but they are really essential. It is only necessary to have one prominent defect manifested at sea to render this clear. There is practically no difficulty in keeping the tubes of a railway locomotive tight. . . . . But at sea the leakage of the tube ends has been fatal to success. . . . . Why is this? . . . . In the railway boiler the grate is kept well below the level of the tubes and a fire-brick arch is thrown across the fire-box. In the marine type the grate is high and there is no brick arch. There is nothing but a low brick bridge. The consequence is that every time the fire-door is opened a current of cold air impinges on the tube plate. Leakage is the immediate or ultimate result. In the railway boiler the white hot brick arch protects the tube ends. . . . . The boilers of the Lepanto are all fitted with a high hanging inclined baffle-brick bridge, as usual in railway practice, in each furnace.

Major Goliani states that "from the very beginning of the preliminary trials, which took place towards the end of last year, the locomotive boilers gave evidence of their good working, which went on trial after trial, so as now to be an established fact. They never primed or gave any trouble whatever."

SEPTEMBER 28. Fire-room practice.

Editorial pointing out the importance of treating firemen with consideration, and providing for their physical comfort to enable them to work well.

OCTOBER 12. Marine engines in the navy.

Editorial criticising Mr. Marshall's attempted defense of the naval engines' performance during the manœuvres. Mr. Marshall is quoted as saying: "So much depends on the 'human factor' in all questions of this nature that it is very doubtful if the present system of running war-ships at their most economical rate, which is very slow when on their passage from port to port, is at all a wise one. Clearly what is wanted is that the engineer officers of all grades should be made as efficient as possible, and the most advantageous course to this end, even from an economic point of view, seeing that frequent manœuvres are very costly to the country, would be that all our war-ships should make their passages at full speed, so as to accustom the engine-room and boiler-room staffs to all the exigencies and requirements of working their engines and boilers at full power and speed."

OCTOBER 19. Marine engines in the navy (letter to the editor).

The failure of war-ships to maintain their trial speeds is nearly always due to inability of the stokers to keep steam. . . . In the trial trips in the navy, first-class stokers are always employed in the stoke-holes, generally in the proportion of one man to three furnaces; and this is, I believe, the rule in the merchant service. I do not believe that there is a single war-ship in which this can be done with the ordinary complement; in fact, it is nearly always necessary to go into two watches, even with coal-trimmers supplied from the deck; besides which, at any rate in the recent manœuvres, about 40 per cent of the stokers were second class—that is, boys about eighteen who had never before been to sea, many of them fresh from the plow. . . . . In the case of ships fitted with forced draft, not only will the boilers not stand a long course of it, but the engine-room staff must be increased considerably if it is intended to keep on for more than twelve hours, as the intense heat soon renders the men incapable of much work. With regard to its effects on the boilers, the chief lesson learnt is that if there is a moderate amount of scale in the boilers it is almost a certainty that some of the furnaces will bulge, owing to pieces of loose scale dropping on them. With regard to naval engines, the very fact that so much power is got out of so small a weight means that greatly increased care in adjusting bearings and watchfulness, when running, is necessary; in fact, I

know of more than one contractor's trial in which all the men in the engine-room—and there were plenty of them—held certificates and had been to sea as engineers in the merchant service. And yet with all this care there are ships in the navy whose machinery has been accepted although the metal has been run and pins scored badly during these trials. . . . . But perhaps the chief cause of hot bearings in the navy is that ships only steam full speed at such rare intervals that no opportunity is given to get the right adjustments for full speed. . . . . As perhaps you know, owing to the small number of engineers in each ship, a great deal of watch-keeping is done by artificers. Now, some of these are very good men; still it is rather strong to have, out of a complement of ten, five who have never been to sea before. . . . . In many ships in the manœuvres there were not two men in the whole staff who had ever seen the ship steam before. . . . . If our war-ships are to go their trial speeds, the stokers must be trained, as seamen are in the Excellent; there must be more of them; the engine-room artificers should also be trained, and should be chosen from other trades than shipwrights, as some have been, and the men should not be changed from ship to ship as they are now.

On the construction of furnaces for burning liquid fuel. Summary of the advantages of liquid fuel.

The Snark.

Letter from the owner of a Zephyr launch built by Yarrow, praising this style of engine.

Note.—In the last number of the Proceedings of the U. S. Naval Institute, by a typographical error, the spirit vapor was stated to be "exploded in the cylinder" instead of "expanded in the cylinder."—Eds. W. F. W.

THE JOURNAL OF THE FRANKLIN INSTITUTE.

June, 1888. Pilot chart of the North Atlantic Ocean.

The conclusion of Mr. Everett Hayden's lecture. Description of the red data on chart—sunken wrecks—charts published and cancelled—notices recommending the use of oil to lessen the effects of heavy seas—brief weather review of the preceding month—derelict vessels, wrecks and drifting buoys. Oceanic circulation in the North Atlantic. Investigations by Lieutenant J. E. Pillsbury, U. S. N., of the Gulf Stream. Drift of derelicts, icebergs, etc.

Electrical distribution of time described, by Commander Allan D. Brown, U. S. N.

July. Electrical distribution of time (continued).

August. Fuel oil; how to burn it; where it is being used; advantages; kind of oil to burn.

September. Influence of aluminium upon cast iron.

A presentation of the remarkable effects of aluminium upon cast iron, giving an idea of the great benefit to iron-founders promised by the rapidly falling price of aluminium.

October. Inquiry into the relative value of aluminium and its alloys in the arts. Methods of production, uses and costs.

R. W.

JOURNAL DU MATELOT.

June 16, 1888. A report of the Minister of Marine, and a decree by the President of the Republic, creating new duties and privileges in the superior grade of warrant officers (Premiers maîtres). New pay-table of the Pilotes-majors.

JUNE 23. A decree by the President regulating herring fishery (a matter of local interest).

JUNE 28. The Oriolle steam boiler for torpedo-boats.

Experiments made at Nantes last June, in the presence of distinguished naval engineers and others, gave very flattering results, and will henceforth render France independent of English industries for the construction of this class of steam generators.

SEPTEMBER 15. Violation of the laws of navigation and ocean fisheries, and measures of repression.

SEPTEMBER 22, 29, OCTOBER 20. Continuation of the article on violations of the navigation and fishery laws, and their mode of repression. The French fleet in 1889 (a list of new vessels building and to be built). J. L.

MÉMOIRES DE LA SOCIÉTÉ DES INGÉNIEURS CIVILS.

MAY, 1888.

This number contains a very interesting article on accidents to crown sheets in steam boilers, by M. S. Perissé, C. E., vice-president of the Association of Civil Engineers. The memoir, with the discussions thereon, take up the greater portion of the volume; also a proposed scheme to supply Paris with water from the lake of Neufchâtel.

AUGUST, 1888. Proposed plans for supplying Paris with water from the Swiss Jura lakes. The necessity of giving Paris an abundant supply of pure drinking water has for some time engaged the attention of French engineers, and several propositions have been made of tapping the lakes of Switzerland for that purpose. The undertaking presents great difficulties, one of which is lack of capital, the estimated cost being no less than 355,000,000 francs. The article is supplemented with descriptive illustrations. Another interesting paper is a memoir on a new generator for the instantaneous production of steam (with drawings). Also an article on elastic deformations. A new theory with applications to arc calculation. J. L.

MITTHEILUNGEN AUS DEM GEBIETE DES SEEWESENS.

VOLUME XVI., NOS. 7 and 8, 1888. A new life-boat.

Messrs. Gray & Hughes, of Liverpool, have constructed a new style of life-boat for use on board ship. Its length is 16 feet, breadth 5 feet 6 inches, depth 2 feet 6 inches. It is built of thin galvanized steel plates, and is divided by transverse bulkheads into twenty water-tight compartments. When the boat is not in use it may serve as a bench on deck. If it is launched while in this form it folds itself into the shape of a boat, and is held in this shape by two hoops placed in the extremities. Its capacity is twenty-five or thirty people, and besides this, it is furnished with life-lines, secured outboard, for the assistance of persons in the water. The water-tight compartments can be used for stowing provisions, etc. The boat is fitted for two masts and sails and is supplied with eight life-buoys. On trial it was found that as soon as the chest-shape deck bench touched the water it was at once converted into a perfectly seaworthy life-boat, fully equipped, and that upon hoisting it on board it resumed its original form.

Automatic closure for ventilator openings in water-tight bulkheads.

According to a short notice in the *Army and Navy Gazette*, it is stated that on the Trafalgar and Nile the ventilator openings in the water-tight bulkheads are fitted with an automatic closure, the invention of Mr. Beck, a foreman in the Portsmouth Arsenal. It consists of a wooden piston and a vertical cylinder, the upper end of which is open and in communication with the compartments on both sides of the bulkhead. The piston is moved when any water which has entered either compartment rises to a certain height; the motion of the piston releases a weighted lever which closes the opening by means of a water-tight slide. This ingenious invention is reported to be very simple and to act with perfect certainty.

Japanese lacquer as paint for ships' bottoms.

Le Yacht states that a Japanese has succeeded in lacquering the bottom of a ship. A wooden steamer, the Fuso-Kan, whose bottom was partly painted with this lacquer, was in service for full eighteen months. At the end of this time it was found that the lacquer had remained perfectly good, and the entire bottom was then lacquered.

This lacquer is said to be equally good for iron ships. It is reported that a portion of the bottom of the Russian cruiser Dimitri-Donskoi, at present in Japanese waters, is painted with this material.

Captive balloons in the French navy.

During the second part of the summer exercises of the Squadron of Evolution, it is said that the practicability of captive balloons was tried on board a steam tug. In addition to this, several people of the navy have been sent from Toulon for a course of instruction in the Central Aeronaut School at Calais-Meudon.

Heavy Krupp guns for Italy.

Krupp has built for the Italian Government a gun weighing 139 tons, which is intended for the first-class battle-ship Sardegna. This gun is 52 feet 6 inches long, and has a caliber of 15.75 inches. The projectiles are steel shell of two descriptions; one light, the other heavy. The first is 3 feet 5 inches long, and weighs 1625.8 pounds; the second is 5 feet 2 inches long, and weighs 2310 pounds. The charge will weigh 1067 pounds, and the calculated I. V. of the heavy shell is 2099 f. s.

100-pounder R. F. G.

According to "Broad Arrow," a 100-pounder R. F. G. (trial gun) is designed, and by this time completed for H. B. M. ships Blake and Blenheim. It will first be mounted on board the artillery schoolship Excellent, and then by way of experiment on the battle-ship of the second class Hero. It is superfluous to add that this is the heaviest rapid-fire gun up to the present time.

An improved sea-water distilling apparatus.

The application of high steam pressures in marine boilers, a consequence in some measure of surface condensation, becomes more dangerous as the pressure rises on account of the salt water feed. It therefore becomes necessary to devise some way of producing fresh water to supply the deficiency of the feed.

The firm of E. Mouraille & Co., of Toulon, which has for years manufactured the Perroy system of distillers, have recently so improved their apparatus that the feed water furnished by it, in addition to the drinking water, can be used in a very simple manner to replace the lost feed. By this method the distillate is obtained under a partial vacuum, and the efficiency of the distiller increased 75 per cent without greater consumption of coal. The boiler feed-water furnished by the apparatus is to a certain extent a residue formed in the production of drinking water.

The essential improvement consists in the employment of a second or auxiliary generator which is used in connection with the main condenser and main hot well, and can be disconnected when desired. It is to be especially observed that when the auxiliary generator is disconnected, as for instance when the engines are not working, the operation of the distilling apparatus still continues in the usual way.

The auxiliary generator, by assisting the action of the coolers, causes a forced production of drinking water, provided that it is disconnected from the main engine, and that the main generator is adequate to this increased supply.

Mouraille & Co. have also improved the main generator by a device which not only has for its object a gain of the return feed-water, but also causes a livelier circulation of salt water through the tubes of the generator to be maintained. Steam is thus more quickly and easily formed, and the tubes remain longer clean. This last circumstance is one of much importance, as the scale that is deposited on the heating surface largely influences the efficiency of the generator, and necessitates frequent scaling.

The principal advantages claimed for the improvements are:

1st. A gain of about 75 per cent of distilled water.

2d. Greater efficiency of the generators, due to the circulation of water inside of them.

A. G.

No. 9. On the methods and means of nautical instruction, by E. Geleich (concluded). Marine engines capable of being partially disconnected. On the maritime defense of England. Yarrow's Zephyr type of engine. The Maxim rapid-firing gun. French barbette cruisers. The new French torpedo-boat Coureur. American armored cruiser. Launching of the dispatch-vessel Jagd, of the German navy. Russian navy. Elimination of the schooner Polarnaja Zwjazda from the list of the Russian fleet and laying on the stocks of a yacht of the same name. Launching of the partially armored frigate Pamjatj Azowa. New orders of examination for officers of the Austrian mercantile marine. Tests of compound and steel armor plates. German dynamite gun. The Perekop Canal. Torpedo-boat for the U. S. of America. Experiments with a new composition paint upon the hull of the Sultan. Literature. Geonomy (mathematical geography) based on observation and elementary calculation, by Th. Epstein. Report of tests of the 7.5 mm. and 8 mm. Rubin rifle-barrels at Berndorf, February, 1888. The nature and treatment of explosives. Weapons of war. Magnetic observations on the southeastern coast of Austria. Manual of the Russian language for the army. Bibliography and official notes (supplement).

Carrier-pigeon stations in France.

The recent experiments with carrier-pigeons, by Vice-Admiral Bergasse du Petit Thouars and the "Société Forteresse," at Toulon (mentioned in our last number) having been successful, the Minister of the French Marine will demand an appropriation for the establishment of maritime carrier-pigeon posts along the coast at the semaphore stations and on board of the men-of-war stationed at the five principal ports of France.

Similar posts of carrier-pigeons could be established in this country at a trifling expense, at our principal seaports and on some of our men-of-war, and would render great service. We suggest the establishment of some experimental stations at Fortress Monroe and Annapolis, communicating with a central post at Washington.

No. 10. The game of naval blockade (paper read by Lieutenant N. Chamberlain, before the Royal United Service Institution). Process of manufacturing the cellulose in France, by Fred. Jedliczka, engineer in the Austrian navy. Study of the physical condition of the Black and Azoff seas, from translations by Professor A. Kaspurek. Krupp's tests with armor-plates. Swedish cast-steel guns. The Nordenfelt torpedo. Aluminium bronze for screw propellers. A dynamite gun for the Italian navy, manufactured in the United States. A Swedish rapid-firing gun. Two recent inventions concerning submarine torpedo-boats. Reducing the powder charge for English guns. Improvements of screw propellers made of steel. Experiments with captive balloons on French men-of-war. Process of "hardening" armor-plates in a lead bath. Stepherd's folding life-saving boat. Bisson's compensated compass. Report of estimates and proposed stations of the French navy for 1889. The English torpedo store-ship Vulcan. The American armor-clad Texas. The English armored cruiser Orlando. Launching of the English cruiser Medea. Construction of cruisers for the U. S. of America. American monitors. Building of new vessels for Turkey. Experimental firing of projectiles filled with melinite. Rapid passage across the Atlantic ocean. Literature: Manual of laws and regulations of marine insurance in force in the principal European countries, by T. Anderson. Official notes, etc. H. M.

MITTHEILUNGEN DES VEREINS FÜR ERDKUNDE ZU LEIPZIG. 1887.

Communications in regard to the Society (Vereins).

Scientific communications: 1. Extracts from the papers of the late Eduard Pöppig. Biography. Paper on vines and parasitical plants. Lecture on the character of the inhabitants of tropical South America. Extract about the Indians of Maynas and the missionaries. The winter and spring 1824–1825 in Pennsylvania. 2. Equatorial limits of snow, by Dr. Hans Fischer. 3. The conditions of the snow on Kilimandscharo during the summer of 1887, by Dr. Hans Meyer.

E. H. C. L.

PROCEEDINGS OF THE AMERICAN ACADEMY OF ARTS AND SCIENCES.

Volume XXIII., Part I, May, 1887, to May, 1888.

John Trowbridge and C. C. Hutchins have investigated the question of oxygen in the sun by photographic comparison of the spectrum of air with the solar spectrum. They find that there is not sufficient coincidence of the lines to warrant the conclusion heretofore drawn that oxygen exists in the sun. A similar investigation by the same authors establishes the presence of carbon vapor in the sun.

C. C. Hutchins and E. L. Holden have discovered platinum in the sun, and have compared with the solar spectrum the spectra of other metals, the existence of which in the sun is doubtful.

O. W. Huntington has compiled a catalogue of all recorded meteorites.

C. R. S.

PROCEEDINGS OF THE CANADIAN INSTITUTE.

APRIL, 1888.

Dr. J. H. Garnier gives the following remedy for snake bites, and cites cases in which it has been efficacious in poisoning from rattlesnake bites: one dram iodide of potash dissolved in two ounces of water, repeated in ten minutes. Then in five minutes an ounce of spirits of nitre is taken, dissolved in water. The theory is that the iodine, freed by the nitrous ether, neutralizes the poison. C. R. S.

REVISTA MILITAR DE CHILE.

VOLUME VI., NO. 1, AUGUST, 1888. War considered as a social necessity, by Lieutenant-Colonel J. C. Salvo. The Comblain rifle, by Lieutenant-Colonel B. Silva Gonzalez. Reformed infantry tactics for quick manœuvring, by Colonel Jorje Wood. Necessary reforms in the infantry branch of the service, by Captain Don Anibal Fuenzalida. Territorial defense, by Captain Don Benjamin Villareal.

J. B. B.

SEPTEMBER. The military mont-de-piété law. Concerning the organization of the Chilean army. Compulsory military service. A new practical school of military engineering in Portugal. Fundamental principles of the efficiency of small-arm firing on the field of instruction and before the enemy. The pay of the navy, army, and national guard. A discussion concerning the different methods of firing. The defense of states. Foreign chronicle. W. E. S.

REVUE DU CERCLE MILITAIRE.

JUNE 17, 1888. Various stages in the history of the torpedo-boat. The sanitary corps of the Swiss army. Instruction in temporary field fortifications in the Russian army (sketches). French and foreign military notes.

JUNE 24. Organization of the active army (infantry): ternary system. Instruction in temporary field fortifications in the Russian army (ended). Physical training in the English army. The German Generals: I. Von Pape; II. Von Kleist.

JULY 1. Civil versus military workmanship (this is an answer to articles published in the Review of January 3 and March 11, 1888). Increase of the corps of cadets in Germany. The new school of cadets at Carlsruhe. Report of Lieutenant-General Pallovicini on the manœuvres executed in the province of Emilia in 1887. Foreign military notes.

JULY 8. Organization of the territorial army: ternary system. The Austro-Russian frontier: the theater of military operations. Considerations upon the defensive organization of Italy, as presented by an Italian. The new school of cadets at Carlsruhe (ended).

JULY 15. Changes in the regulations touching the interior routine in the corps of artillery and ammunition train. The plan of defense of the Jura mountains. Eventuality of a concentration of German

and Italian forces in the upper plains of Switzerland. The German Generals (continued): III. Von der Burg; IV. Von Wartensleben. Military chronicle.

JULY 21. Defense of Cherbourg by means of torpedoes (with illustrations). The Austro-Russian frontier: the theater of military operations. The beginning of a conquest. Algeria from 1830 to 1840. Military chronicles.

JULY 29. Mounted infantry: their use in the southern division of the regency (Africa). Military pensions in Italy.

AUGUST 5. Plan of a target with automatic shot-recorder (with illustrations). The army of Morocco. Reorganization of the school of war in Vienna. Imaginary battles: the battle of Belfort. England's death-throes. Rome and Berlin.

AUGUST 12. Plan of a target, etc. (see August 5). Fighting on foot in the Russian cavalry. The German Generals (continued): V. Von Grolman; VI. Von Meerscheidt-Hüllessem.

AUGUST 19. Changes in the composition of military bands. Plan of a target with automatic shot-recorder (ended). By-laws of the German officers' association. Recent photographic works; proofs from balloon or at a distance.

AUGUST 26. A study on recruiting and mobilization. The English soldier at Gibraltar. Night attacks. Recent photographic works; photography without object-glass.

SEPTEMBER 2. Defensive organizations of the coasts of England. Fire regulations for infantry in the German army, approved February 22, 1887: analysis and criticisms. A study on recruiting duty and mobilization. German Generals (continued): VII. Von Böhn. Emperor Nicholas and the Cosaks. Foreign military chronicle.

SEPTEMBER 9. Neutrality of Switzerland. Fire regulations for infantry in the German army, etc. (continued). A study on recruiting duty and mobilization (ended). Foreign military chronicle. Three considered as a tactical unit.

SEPTEMBER 16. Neutrality of Switzerland (end). Comparative study of the French engineer corps and those of the principal European armies. Regulations for infantry firing in the German army. Foreign military chronicle.

SEPTEMBER 23. The army exhibition in 1889. Comparative study of the Engineer Corps in France and in the principal European armies (ended). The military future of China.

SEPTEMBER 30. The Italian naval manœuvres of 1888: report of Vice-Admiral Acton. Military bread-making. The army of Persia.

OCTOBER 7. Necessity of reducing the weight carried by the infantry soldier during a campaign. The native army of India: 1. The Bengal troops. Italian naval manœuvres (ended). Horse batteries of the Russian cavalry divisions. English experiments in the use of luminous compounds during night operations.

OCTOBER 14. A study of the composition and distribution of the French fleet. The Russian army in the field. The corps of military cadets in Switzerland. The magazine rifle question in England and in the principal European states.

OCTOBER 21. A study of the composition and distribution of the French fleet (ended). The Russian army in the field (continued). Casualties in battle. The army exhibition in Paris, 1889. Notes on the causes of differences in the number of revolutions of independent twin-screws and the means of correcting them. Scientific mission to Cape Horn (1882–3); history of the voyage (continued). A night patrol recorder. Eastern affairs (1839, 1840, 1841); diary of an officer on the naval station of the Levant. Historical studies of the French navy. Chronicle—English navy. Naval manœuvres. General orders of Vice-Admiral Baird. Conclusions drawn from the naval manœuvres. Certificates of specialty to navy lieutenants. The Mediterranean squadron. Armament of the armored ship Hector. The German pneumatic gun. Construction of new torpedo cruisers and rapid advice boats. New Spanish cruisers. Launch of the English cruisers Medusa and Marathon, and Italian cruiser Piemonte. Trials of the first-class English gunboat Pheasant, Spanish armored ship Pelayo, and Italian armored ship Lepanto. Fortifications of the Caprera and Maddalena islands. Bombardment of seacoast open cities. The Howell torpedo. Folding life-saving boats.

J. L.

REVUE MARITIME ET COLONIALE.

JULY, 1888. Elements of international maritime law (continued). General report on the sardine fishery by the chairman of the committee on ocean fisheries (ended). The Rio Janeiro expedition of 1711 (see preceding number). Violation of the regulations concerning navigation and ocean fishery, and measures of repression. A memoir on public education in some of the states of South America. Foreign chronicle—English navy; Transportation of an army across the Channel; Naval defenses; The naval reserve; The coming great naval manœuvres; Protection of the merchant marine; Reception of stores and supplies in arsenals; Spanish navy; The centenary of the Marquis of Santa Cruz artillery; Experiments on armor plates at Portsmouth; New experiments with high explosive shells against the Résistance; The steel-wire wound gun; The guns of the Collingwood and Téméraire; Petroleum navigation in the Caspian Sea; Establishment of a large dockyard at Bilbao; The game of blockade; New Italian torpedo-boats.

AUGUST. Elements of international maritime law (continued). A memoir on public education in some of the states of South America (ended). Scientific mission to Cape Horn (1882–1883). The Shamrock's mishap and its temporary repair. Newfoundland. The cod and lobster fishery. Prizes awarded for the best articles published in the *Revue Maritime et Coloniale*. Foreign military chronicle—Opinion of an American admiral in regard to a successful invasion of England;

Responsibilities of the Board of Admiralty; The medical service of the fleet; The speed of cruisers; The defenses of coaling stations; The great manœuvres of the Italian fleet; The new Maxim gun; First experiment with an Italian pneumatic gun; Bellite; Smokeless powder, etc.

SEPTEMBER. A trip to the lakes of Cambodia.

The writer, a lieutenant in the French navy, gives a graphic account of his voyage up the Cambodia river, on a mission to study the numerous fisheries established by the Asiatics on the lakes of the ancient kingdom of Khmer.

A scientific mission to Cape Horn (1882–1883); history of the voyage (continued). Comet perceived at Papute in January, 1887; observations made by M. de Kerillis, lieutenant French navy. Foreign chronicle—State of protection of the English dockyards; Appropriations for the construction and armament of new gunboats in United States; Purchase of auxiliary cruisers by the Italian Government; Review of the Black Sea squadron (Russia); Experimenting with melinite shells at Portsmouth, England; Coast defense artillery in England and Russia; Launch of the Charleston, U. S. A.; Disappearance of Sable Island; The Berdon torpedo before the Senate Naval Committee; Mémoires et Compte rendu des travaux de la Société des Ingenieurs Civils.

JULY, 1888. A visit to the establishment of the Parisian Compressed Air Company. Portable economical bridges, Eiffel system; their use in Cochin China and Tonkin, and in repairing railroads. Memoir on the Garabit viaduct—the latter article takes up the larger portion of the volume (drawings). J. L.

RIVISTA DI ARTIGLIERIA E GENIO.

MAY, 1888. Field-hospitals at the Antwerp exposition, 1885 (with numerous plates), by F. Baroffio and C. Marzocchi. On the Bênier hot-air motor (with plate and description), by G. Ninci, captain of artillery. Italian field artillery (historical), by Carmine Siracusa, captain of artillery.

JUNE, 1888. Repeating arms. Study on the repeating arms of Germany, by I. V. (with plates). The Dreyse model of 1879—magazine along the barrel. The Bornmüller, Simson, and Luck model of 1882—magazine in the butt. Also model of 1884. Sporen and Härl model of 1882. Härl, Schmidbauer and Löwi (simplification of the preceding). Bertoldo model of 1885, with magazine under the breech. Adaptation of the Mauser model of 1871–84—supply tube in fore-end of stock.

JULY–AUGUST. Iron in fortifications (*àpropos* of a new book by General Brialmont), by F. Le Forte, major of engineers. J. B. B.

RIVISTA MARITTIMA.

JUNE, 1888. The arrangement of torpedo-launching apparatus on men-of-war, by L. Armani, captain Italian navy.

A brief historical sketch, followed by conclusions as to the best position for the apparatus, and the conditions for successful launching from bow, beam, and stern.

JULY–AUGUST. Trieste and its port, by E. Borgatti, C. E.

An interesting description of the city, with its commercial improvements; illustrated.

Shells charged with gun-cotton against fortifications (translation from *Engineering*). Melinite against forts (translation from *Le Genie Civil*).

SEPTEMBER. The war in Cyprus (a historical essay of events during the 15th century), by Vice-Admiral L. Fincati. Repairing the broken shaft of the steamer Perseo in mid-ocean (account by Chief Engineer Grillo Salvatore). Naval mobilization in the United Kingdom, Rear-Admiral P. H. Colomb. The pilot chart of the North Atlantic ocean (issued by the Hydrographic Office, Washington), description of, by A. G. Discussion of naval affairs in the U. S. Senate. Propulsion by hydrocarbon vapor. J. B. B.

ROYAL ARTILLERY INSTITUTION.

VOLUME XVI., NO. 8. The pneumatic dynamite cannon.

This paper contains a description of Mr. Medford's dynamite gun, and claims advantages for this arm over Zalinski's which may be classed as follows:

1. Construction of gun, giving greater strength.
2. No angles in the channels connecting reservoir and barrel, thus transmitting an undiminished pressure from reservoir to base of projectile.
3. The use of powder in connection with compressed air, thereby doubling the initial velocity and driving back the air to reservoir.
4. Dispensing with mechanical devices to keep projectile steady, by rifling the bore. M. K. E.

ROYAL UNITED SERVICE INSTITUTION.

VOLUME XXXII., NO. 144. Naval mobilization. The game of naval blockade.

A simple game. If introduced aboard ship, might be found interesting and instructive.

The position of the torpedo in naval warfare.

Compares gun and locomotive torpedo, to the detriment of the latter. Discussion of this paper by the members brings out many valuable points.

M. K. E.

TEKNISK TIDSKRIFT.

18TH ANNUAL SERIES, VOLS. II. and III. Competitive designs for the new Royal Theater at Stockholm. Masonry during cold weather. Development of telephone service in Christiania. Latest progress in the science of graphic statics. Coal-yard and harbor of the Stockholm gas works. Statistics in regard to mineral productions in Sweden in 1886. E. H. C. L.

UNITED SERVICE GAZETTE.

JUNE 16. Account of experiments with smoke-burning apparatus on H. M. S. Orlando.

JUNE 23. Experiments with Nordenfelt electrically controlled torpedo. Faulty English gun-construction.

JULY 7. Maritime dangers and defenses.

JULY 14. Naval defenses.

JULY 21. Programme of British naval manœuvres.

JULY 28. Views of Admiral Hornby on the number of ironclads necessary to blockade an enemy's fleet. Naval manœuvres.

AUGUST 4. Naval manœuvres.

AUGUST 11. Naval manœuvres.

AUGUST 18. Naval manœuvres.

AUGUST 25. Result of naval manœuvres.

Account of rifle fire at night by electric light; range 400 meters. Nine shots out of ten struck the target.

Naval defenses.

SEPTEMBER 1. Machine guns in future warfare. Maxim gun and new army rifle.

SEPTEMBER 8. The new rifle. English small-arms.

Committee convinced that small-bore rifle is superior to large.

SEPTEMBER 8. French submarine boats invented to dive under ironclads, fasten torpedoes to her sides and explode them by electric cables.

SEPTEMBER 15. 36-pounder Armstrong gun.

Caliber 4½ inches, has been found fit for service. Eleven projectiles per minute. Penetration at 1000 yards, 6-inch wrought-iron armor plating.

Lessons taught by recent British naval manœuvres. Russian naval manœuvres.

SEPTEMBER 29. Noiseless and smokeless gunpowder.

Experiments about to be made with "safety" gun, discharged by steam, pressure 200 pounds per square inch.

OCTOBER 6. Pneumatic dynamite cannon.

Rapid-firing guns, recommended by Lord Armstrong, firing twelve shots per minute. Considers the Piemonte, just launched for the Italian Government, best armored ship afloat.

New torpedo-boats.

OCTOBER 13. New paint for ships.

OCTOBER 20. Preliminary trials with new small-bore rifle successful. British national defenses and commerce, I. M. K. E.

LE YACHT.

JUNE 16, 1888. A study on fighting ships (continued). Barbette cruisers in course of construction.

JUNE 23. The question of cruisers in the House of Commons. The Yacht Club of France at the Exposition of 1889. A study on fighting ships (continued). Review of the merchant navy.

JUNE 30. Mobilization of the fleet. A study on war ships (ended). Paris a seaport. This question has again received an important impetus, the Chamber of Deputies having, through a resolution, invited the Government to take active steps in regard to the proposed ship canal between Paris and Rouen.

JULY 7. Inefficiency of torpedo-boats on the high seas. Collisions at sea. Formation in Paris of the Society of Engineers and Naval Constructors. The greyhounds of the North Atlantic. Manœuvres of the Mediterranean squadron.

JULY 14. Collisions at sea (continued). Siriux' compensated compass (diagrams).

JULY 21. Mobilization of the English fleet. New petroleum steam motor.

JULY 28. Strengthening the defenses of the military ports of France. Trial of the armored ship Pelayo.

AUGUST 4. French naval appropriations for 1889. Second-class fast cruisers in England. The Life-Saving Service and Hygiene Exhibition at the Industrial Palace, Paris.

AUGUST 11. Manœuvres of the English squadrons. Use of balloons in the navy.

AUGUST 18. Manœuvres of the English squadrons. Mobilization of the French fleet. Naval schools of England and scientific education of English officers.

AUGUST 25. The summer manœuvres—England, France, Italy. Official trial of the armored ship Pelayo.

SEPTEMBER 1. The mobilization at Toulon. Instantaneous steam generator, Serpollet system. Review of the merchant navies of France, Spain, United States, Japan, Austro-Hungary, Germany, England.

SEPTEMBER 8. The mobilization at Toulon. Twin-screw torpedo boat built by M. Normand, Havre. Electricity on board the armored ship Pelayo. Trials of the Italian armored ship Lepanto. Instructions in regard to the use of the Belleville boilers.

SEPTEMBER 15. More about the English naval manœuvres. The defenses of the dockyards and military ports of France. The armored division of the Channel at Cherbourg and Havre. New formula for calculating the action of the rudder. Foreign military chronicle.

SEPTEMBER 22. From Toulon to Cherbourg (E. Weyl). Keel

or centerboard? (L. Moore). Considerations of tactics to be adopted in case of war with a great naval power. K . . .

SEPTEMBER 29. The navy budget in the French Naval Committee. Considerations of tactics . . . (ended). Life-Saving Service Exhibition: Horticulture on board ships (L. C.). Torpedo boats built in France for the Roumanian Government. The new marine engines.

OCTOBER 6. Considerations of the different types of modern war ships (G. Rebard). Trials of the engines of the Victoria and Sans-Pareil. Maritime jurisprudence; collisions at sea. Modern naval improvements: to Gibraltar and back.

OCTOBER 13. Reforms in the naval budget. The German armored corvette Irene. Life-Saving Service Exhibition at the Palais de l'Industrie, Paris. Considerations of the different types of modern war-ships (continuation of a very valuable article). Keel and centerboard.

OCTOBER 20. About the naval review at Naples (E. Weyl). End of the article on the different types of modern war-ships. Transportation by Decauville railway of the gunboat Farcy (with illustrations).

J. L.

REVIEWERS AND TRANSLATORS.

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SPECIAL NOTICE.

NAVAL INSTITUTE PRIZE ESSAY, 1889.

A prize of one hundred dollars and a gold medal is offered by the Naval Institute for the best Essay presented, subject to the following rules:

1. Competition for the Prize is open to all members, Regular, Life, Honorary, and Associate, and to all persons entitled to become members, provided such membership be completed before the submission of the Essay. Members whose dues are two years in arrears are not eligible to compete for the Prize until their dues are paid.

2. Each competitor must send his essay in a sealed envelope to the Secretary and Treasurer on or before January 1, 1889. The name of the writer must not be given in this envelope, but instead thereof a motto. Accompanying the essay a separate sealed envelope will be sent to the Secretary and Treasurer, with the motto on the outside and writer's name and motto inside. This envelope is not to be opened until after the decision of the Judges.

3. The Judges shall be three gentlemen of eminent professional attainments (to be selected by the Board of Control), who will be requested to designate the essay worthy of the Prize, and, also, those deserving honorable mention, in the order of their merit.

4. The successful essay shall be published in the Proceedings of the Institute; and the essays of other competitors, receiving honorable mention, may be published also, at the discretion of the Board of Control; and no change shall be made in the text of any competitive essay, published in the Proceedings of the Institute, after it leaves the hands of the Judges.

5. Any essay not having received honorable mention, may be published also, at the discretion of the Board of Control, but only with the consent of the author.

6. The subject for the Prize Essay is, *The Naval Defense of the Atlantic and Gulf Coasts of the United States.*

7. The essay is limited to seventy-two (72) printed pages of the Proceedings of the Institute.

8. All essays submitted must be either type-written or copied in a clear and legible hand.

9. The successful competitor will be made a Life Member of the Institute.

10. In the event of the Prize being awarded to the winner of a previous year, a gold clasp, suitably engraved, will be given in lieu of a gold medal.

By direction of Board of Control.

CHARLES R. MILES,
Lieut., U. S. N., Secretary and Treasurer.

ANNAPOLIS, MD., *March* 1, 1888.